1624 Eye Street, NW
Washington 6, D. C.
Phone: EXecutive 3-3033

Editor
W. J. BAIRD

Advisory Editor
ROLAND C. DAVIES

Managing Editor
JUDITH H. SHREVE

Chapter News Editor
JULIA B. GODFREY

Associate Editors
CHARLES DeVORE
GEORGE C. RUEHL, Jr.
DR. HAROLD A. ZAHL
EDWARD K. KAPRELIAN

Editorial Assistants
G. B. HOELSCHER
R. A. GALLAGHER
S. E. HOOD

Contributing Editors
T. E. GOOTÉE

Photo News
FRANK SMITH

Army
LT. COL. KENNETH E. SHIFLET, SigC.

Navy
CAPTAIN ROBERT A. WEEKS, USN

Air Force
COLONEL LAWRENCE C. SHEETZ, USAF

SIGNAL is published monthly by the Armed Forces Communications and Electronics Association at 1624 Eye St., N. W., Washington 6, D. C. Second class postage paid at Washington, D. C., and at additional mailing offices.

Subscription rate to members of the AFCEA: 1 year (12 issues), $5.00. To non-members, $7.00. To foreign post offices, $8.00. Single copies, $1.00 each.

All rights reserved. Copyright 1959 by Armed Forces Communications and Electronics Association. Reproduction in whole or in part prohibited except by permission of the publisher.

Printed in U.S.A. by Monumental Printing Co. at Baltimore, Md. The publisher assumes no responsibility for return of unsolicited manuscripts or art. When sending change of address, please list the old and the new address, and allow 3 weeks for delivery of first copy.

BPA

SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XIV OCTOBER 1959 NUMBER 2

CONTENTS

Electronics Looks Ahead to 1975 4
H. Leslie Hoffman

Aircraft Accident Investigation and Air Safety 7
Harmar D. Denny

Introducing the New Tunnel Diode 10
Dr. Malcolm H. Hebb, Dr. Jerome J. Tiemann and H. Brainard Fancher

Stratoscope I 16
S. E. Hood

Safety Instrumentation for Tactical Missile Ranges 18
Colonel C. W. Gibbs, USA

The Mobile Digital Defense Environment 27
Dr. N. A. Begovich and Brigadier General Earle F. Cook, USA

Vehicle-to-Vehicle Ground-Wave Propagation Characteristics 30
W. S. Bennett and L. R. Alldredge

New Code Course Tested at Fort Monmouth 38
Lieutenant Colonel Walter White, Jr., USA (Ret.)

Convention Panel Discussion 41
Lieutenant Colonel Edgar J. Masters, USAF

Cover

The balloon-telescope-camera of Project Stratoscope I is shown at moment of launching from Lake Elmo, Minnesota, on August 17, 1959. The flight began at dawn and ended seven hours later when the telescope-camera, after photographing sun spots and the magnetic area near sun spots, was carried back to Earth by parachute. The cover photograph was released by the National Science Foundation who co-sponsored the Project with the Office of Naval Research. *See page 16.*

DEPARTMENTS

Signalgram 21
Association Affairs 46
New AFCEA Members 47
Chapter News 48
Chapters and Chapter Officers Directory 49
Sustaining and Group Member Directory 51
News Items and New Products 52
Names in the News 60
Books 62
Index to Volume XIII 64
Index to Advertisers 68

Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.

electronics looks ahead to 1975

by
K. LESLIE HOFFMAN
President
Hoffman Electronics Corp.

LOOKING BACK over the past 15 years, I am reminded of a famous quotation by Teddy Roosevelt, who had this to say on new ideas: "First they will be angry with you; then they will adopt the idea; the leaders first, the followers afterward; then they will make the idea their own, a habit; then they will go further than you ever expected or dreamed of." This has certainly been true of us in electronics.

On October 4, 1957, the confidence with which we viewed our technical achievements during the past 15 years was somewhat shattered with the launching of the Soviet Sputnik. The impact of this launching on the national conscience was great. After the first hysteria we began to reexamine not only our weapons but our educational processes, our planning processes and our procurement methods. It was at this time that the famous remark that, "Anyone who is not thoroughly confused just doesn't understand the situation," was originated.

However, industry and scientists responded spontaneously and enthusiastically and, in an amazingly short period of time, sparked by scientists at Jet Propulsion Labs of California, our country also had a satellite in orbit.

Other 20th century discoveries have increased the human capacity for speed, for communication and for destruction, but it has been over 400 years since a whole new geographic area had been opened up to exploration. Naturally this was an earth-shaking event. For the first time in world history men were no longer chained to their tiny planet.

Today—and the Future

Much could be written about the trials and tribulations of the past 15 years but our job today is one of progress. So, let's look ahead and try to visualize what lies in store for us.

What does the future hold? One thing we can count on as a certainty is change. Change is inevitable, healthy and is to be expected in electronics, the most explosive industry from a growth standpoint in America today.

Western Electronic Manufacturers Association itself reflects this growth. Its initial membership of 25 has grown to 300 out of 770 electronic manufacturers in the West. This year, electronics in the 11 Western states will bill an estimated $2 billion—approximately 40 times its level of 15 years ago. Our volume, in other words, has doubled every three years. The AFCEA has reflected this growth with approximately 200 group member companies, compared to a handful a few years ago, and a monthly SIGNAL Magazine circulation of approximately 12,000.

Some of our companies employ more people today than the entire industry did 15 years ago. Our facilities and management techniques have reflected this radical change. Our financial statements have improved. The public has expressed confidence in our future by making sizable investments in our companies.

Here in the West we employ 150,000 persons with a payroll of upwards of $650 million. In California, electronics has become the second largest employer. Nationally, we have moved from 49th in sales volume to 5th in the last decade.

We have a right to be proud of these accomplishments. We have played a prominent part in an era that saw the most accelerated and most concentrated rate of scientific discovery in the history of man. We are destined to play an even greater role in the future.

Before discussing our industry, however, let us recognize that its future must be closely identified with our national objectives. One of these is that we must maintain our retaliatory power at such a level that any potential aggressor can never rationally calculate on a bearable victory.

We can dispel any false optimism about the easing of world tensions. We must be on guard today, more than ever, against any wishful thinking to the effect that the Communist conspiracy for world domination has weakened. It hasn't. The tactics have changed but the objective remains the same.

Another national objective, and an equally important one, is the maintenance of a dynamic but stable economy; stable through heading off of inflation, and dynamic through the growth and development of new markets, new products and new services in our civilian economy.

Electronics can be the pace setter for the accomplishment of both of these major objectives.

Before we go any further let us stop for a moment and examine just what our opportunities and responsibilities are in meeting the first of these objectives—that is, maintaining our technical and weapon superiority.

Our military electronics dollar has grown from $560 million in 1950 to an anticipated volume this year of $4,475,000,000—an increase of 700%. Despite the fact that our national defense budget is expected to remain at the $40 billion to $45 billion per year level during the next 10 years, the forecast is that by 1970 our military electronics volume could well reach $9 billion to $10 billion. This means that the electronic content of the defense budget may more than double during the next decade.

There will be technical changes as we shift from manned aircraft to missiles and space vehicles. New requirements in concepts will spawn new materials, new components and new end equipments.

There will be changes in our procurement procedures. Increased political pressures will be brought to bear to award military contracts on other than a basis of competence. This we should resist with all of our individual and combined strength.

Competition among companies will increase.

Military equipments and systems will become fewer in number but more complex. The engineering content of each equipment will expand materially.

Our electronic industry here in the West has been the pace setter in military electronics with our advanced work on rockets, missiles and space technology, our systems concepts and our new components, but we cannot afford to relax and assume that we will maintain this position without continuing to demonstrate leadership.

We should remember that we here in the West must have a higher creative content per dollar, or per pound, in our products and services in order to compete successfully in either the military or non-military market.

Now let's look at National Objective No. 2, which falls in the non-military field. How can electronics spark an expansion of present markets and build new ones, both within and outside our own industry?

We are blessed with the greatest accumulation of new scientific knowledge and technical breakthroughs that any generation has ever possessed. We here on the Western slope have one of the highest concentrations of top technical and scientific personnel of any place in the world today. How can we harness their capabilities? Let's look for the answer to that in our non-military market potential.

Our consumer products or entertainment devices have shown little growth from the $2.3 billion in 1950 to $2.6 billion of this year. However, the forecast for 1970 is a volume of $3.8 billion, an increase of 47%. I am confident that if we can establish new breakthroughs in this already established market this volume can be materially increased.

Component parts, repairs and services amounted to $758 million in 1950, and this year it is anticipated a volume of $2.6 billion, or a 250% increase. The growth of this phase of our industry is interdependent upon the marketing of end equipment. Consequently, it is anticipated that a growth of approximately 40%, or $3.6 billion by 1970 is an attainable goal.

Dramatic Growth

Our industry's greatest new market is in commercial and industrial electronics. This has shown a dramatic growth from $676 million in 1950 to $2,466,000,000 this year and it is anticipated that this market can grow to a $6 billion market by 1970.

However, just because a company is in this fabulous electronics industry is no guarantee of success. It is a safe assumption that on our 25th anniversary there will be more people employed by fewer companies. Who among us will fail to make the grade? According to Dun & Bradstreet, 65% of the failures in all business in 1958 were due to lack of sales or lack of customers. These companies, in short, lacked marketing capability.

Many of our people have never designed, manufactured or sold to any other customer except the Government. Our industry's greatest single need today, in my opinion, is to build our marketing capability to the level of our technical capability.

In general, our ability to stay ahead technically, and produce, far outweighs our ability to distribute a product. Let's admit it, those of us to whom this applies, and begin to reappraise the need and ways and means, of expanding our markets now.

The key to our marketing problem, it seems to me, lies in getting our companies customer oriented. We must find out what the customer wants first, then determine how best he can be served. It is important that we begin to bring the problems of industry and commerce into our laboratories. Our laboratories can provide the answers, we know, but as of today they still don't know what the problem is. People in industry, who know what the problem is, have not yet learned what electronics can do for them.

Proper marketing will find a way to bring these interests together, and, by so doing, uncover some of the greatest potentials in the history of our industry.

If we can accomplish this cross fertilization, in fact, I am confident we will see even greater technical breakthroughs than we have seen so far. And why not? Who would have thought, only three years ago, that Explorer VI would be in orbit today, speaking to us from 25,000 miles in Space through radio equipment powered by electricity converted directly from sunlight? We have accomplished the seemingly impossible in Space; why not in our own homes, offices and plants?

Now, to get down to cases, let's ask ourselves what we can do individually, and collectively, to bring about this marketing revolution so badly needed in electronics.

The first step, I would say, is up to us as management. We must recognize the need to expand our product base, and diversify our customers; we must accept marketing as a top priority function. We need a plan and, many of us, I am sure, need professional help because marketing is a profession.

This is an attitude that technically oriented management sometimes finds hard to embrace. The technical man's thinking is based on logic. Marketing, however, is a combination of logic and emotion.

We should recognize, in addition, that there is a vast difference between selling and marketing. Selling is only one function of marketing. Marketing normally encompasses sales planning and policy; sales organization, training and compensation; sales forecasts, quotas, budgets, controls; selling operations; industry and customer relations; pricing; advertising, sales promotion, publicity and public relations; market research and development, and the economic evaluation of a new product.

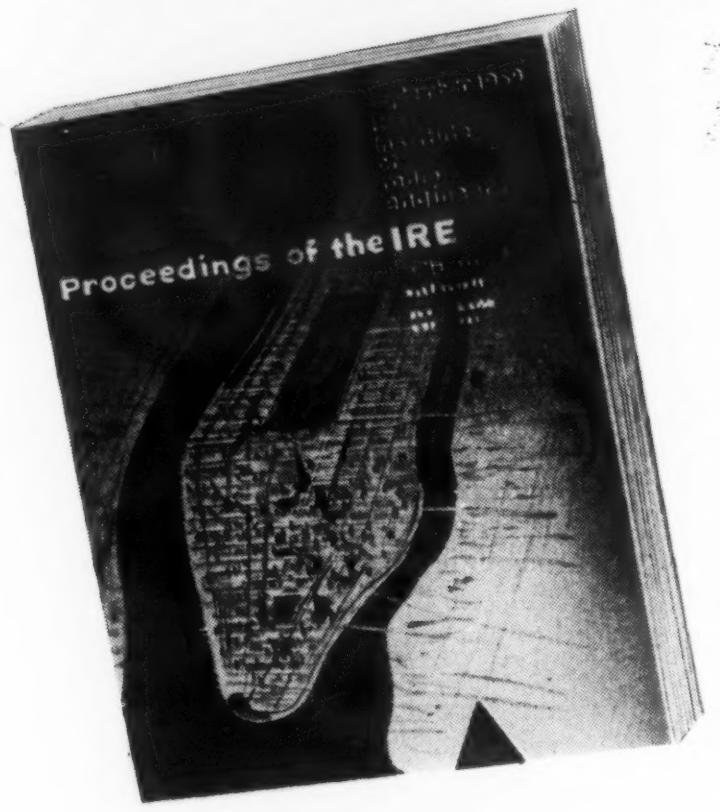
We must encourage closer coordination between market and product research so that the end result is a salable commodity. I think that from a commercial viewpoint this is practically an unexplored area of modern management.

(*Continued on page* 20)

As Comprehensive A Review of

INFRARED

as Security Restrictions Will Allow!



The turning point in the practical application of infrared to military problems was during World War II when the Allies discovered the German Army was using infrared for secret signaling between infantry troops, for the surveillance of Russian tanks supposedly secure in the darkness, and for the detection of Allied night bombers which confused radars by the use of chaff. The turning point for the commercial application of infrared came about the same time when the American synthetic rubber program required rapid analysis of the C_4 fraction in butadiene production. Since this could best be achieved through infrared spectroscopy, commercial infrared spectrophotometers for chemical analysis began to appear in 1943.

Today, despite great advancements in the application of infrared to military and commercial uses, it appears to be only on the threshold of its full realization. That's what makes infrared such an exciting and challenging topic to investigate.

SEPTEMBER PROCEEDINGS OF THE IRE EXPLORES ENTIRE INFRARED FIELD

This special INFRARED ISSUE of the Proceedings of the IRE is the first unclassified American publication to bring together in one place the bulk of the basic information on infrared physics and technology. The material is current, authentic, and much of it recently declassified. It was prepared under the auspices of the Infrared Information Symposia (IRIS), an organization sponsored by the office of Naval Research and under joint-service direction.

This comprehensive review of a rapidly growing science—infrared—is only one of the many services offered members of the IRE. Non-members of the Institute of Radio Engineers, however, are invited to reserve a copy of this vital issue by returning the coupon below, today.

PARTIAL CONTENTS OF THIS INFRARED ISSUE:

Preface, by Dr. Arthur R. Laufer.

Infrared, a New Frontier of Physics and Technology, by Dr. Stanley S. Ballard.

A History of Infrared, by Dr. Warren N. Arnquist and Dr. E. Scott Barr.

The Physics of Infrared, by Dr. Lewis E. Larmore.

The Infrared System, by Dr. Sidney Passman.

Applications, by Dr. Paul J. Ovrebo and Dr. R. Bowling Barnes.

General Bibliography, by Mr. William Wolfe.

PROCEEDINGS OF THE IRE
1 East 79th Street, New York 21, New York

REMEMBERS THE MAN

☐ **Enclosed is $3.00**

☐ **Enclosed is company purchase order for the September, 1959, issue on INFRARED.**

Name_____

Company_____

Address_____

City & State_____

All IRE members will receive this September issue as usual. Extra copies to members, $1.25 each (only one to a member).

THE INSTITUTE OF RADIO ENGINEERS
1 East 79th Street • New York 21, New York

aircraft accident investigation and air safety

by HARMAR D. DENNY
Member, Civil Aeronautics Board

I WISH TO express my appreciation to SIGNAL Magazine for inviting me to write on the general subjects of air safety or international air routes. Inasmuch as both of these subjects are highly complex, I think from a viewpoint of interest, I shall confine my brief remarks to the phases of air safety connected with aircraft accident investigation.

At the outset I should like to remind you that the Federal Aviation Act of 1958 has recently become effective, and this Act establishes the Federal Aviation Agency that is taking over the old Civil Aeronautics Administration of the Department of Commerce. This new agency is independent of the Commerce Department and for the first time brings under the jurisdiction of a single Federal agency the increasingly important problem of air traffic control.

In addition, the safety rule-making function which has been exercised by the Civil Aeronautics Board since 1940 is now transferred to the new FAA. This means that the Board's role in the rule-making process will be as an interested party in any proceeding, expressing our thoughts and beliefs on any proposed rule in the field of safety regulations by the FAA. We shall continue to voice our views on such matters, but the final decision will rest solely within the jurisdiction of the FAA.

Otherwise, the new FAA will not interfere with or overlap the functions of the CAB which is an independent agency of the Congress. Our major functions will continue without change. In the economic field, among other things, these involve the judicial processes of selecting and authorizing air carrier operations over specific routes, both on an irregular and scheduled basis; determining the rate of pay receivable by air carriers for transporting mail; establishing the subsidy rate for scheduled air carriers when necessary; and many other economic functions including setting rates and tariffs for U. S. domestic air carriers.

However, in the field of safety, inasmuch as we are no longer in the law-making business of establishing safety rules, our activities will be principally centered in the wide field of civil aircraft accident investigation. This is not a new field of endeavor for the CAB; it has been one of our more important functions since the inception of the independent Board in 1940. Indeed, I do not consider it immodest to point out that the skills and techniques developed by the Board in the field of aircraft accident investigation have served as a model for more than a score of the leading nations of the world who have sent air safety delegations to Washington to study and copy Board operations in this field.

The reason for this world-wide interest in the accident investigation techniques and procedures of the Board is due to the fact that when it is possible to determine the cause of an accident it is also possible to take measures to prevent similar accidents. It is, perhaps, an enigmatic axiom to say that "out of every accident comes greater safety" but the record will bear me out when I say that the findings made by the Board during the past eighteen years of accident investigation have resulted in hundreds of measures of protection and correction that helped prevent additional disasters.

Very briefly and in general terms only, I should like to outline the procedures followed by the Board in the aeronautical detective work necessary to find the cause of an aircraft accident. Regardless of the location of the accident, if it is within the continental limits of the United States, one of our field investigators proceeds immediately to the scene, has the area roped off and guarded, and impounds the wreckage in the name of the Civil Aeronautics Board. After a preliminary analysis, the investigator calls Washington for whatever accident investigation specialists he determines will be needed, such as experts in power plants, propellers, aircraft structures, airline operations, or meteorologists.

With the arrival of these men on the scene, the CAB investigator-in-charge sets up a number of investigation teams, each headed by a CAB expert. These teams will be composed of representatives of the airline involved in the accident, the manufacturer of the airplane, and representatives from the Air Line Pilots Association, the Air Force, the Navy, Coast Guard, and others. Such teams, therefore, consist of a half dozen specialists working closely together in a common cause to help determine how and why the accident occurred.

In the average case, usually three or four such teams work at the accident scene from several days to several weeks. They may consist of a Structures team, whose responsibility is solely to concentrate on the structure of the airplane; a Power Plant team, which devotes its attention only to the engines of the aircraft; an Operations team, who impounds all records of the flight, the course followed and the navigation and radio facilities used up to the time of the crash, and finally a Witness Interrogation team, which interviews people who saw the accident or observed the aircraft immediately before or after the accident occurred.

When all data by these teams is completed, the Board convenes a public hearing, which is fact-finding in nature and not an adversary proceeding in any way. Such hearings follow civil court procedure in the introduction of evidence and the swearing and questioning of witnesses. Subsequent to the public hearing, which usually lasts three days, a complete report by the Board setting forth its findings, conclusions and recommendations is issued over the signature of the Board Members.

The Board has determined the cause, based on findings and fact,

of more than 90 percent of all the civil air carrier accidents it has investigated in the past 18 years. In addition to the work of the aeronautical experts I have described, the Board utilizes all types of outside technical consultants and laboratories in various fields of science whenever it deems it necessary in the course of accident investigation.

Some years ago the Board had a case that involved the fatal crash of an airline instrument-test airplane that crashed and sank in Bowery Bay following a missed approach into LaGuardia Field. The Board was exceedingly disturbed because the autopsies performed on the two pilots by the New York City Medical Department revealed overwhelming evidence of alcohol in the bodies of both pilots. The newspapers obtained this information and played up the story with strong overtones implying that both pilots must have been drunk at the time of the accident. This charge—which seemed to be true on the face of the evidence—began to seriously affect public confidence in all air transport operations.

Now, anyone who even remotely understands the highly technical and specialized work performed by airline flight crews today also knows that it would be impossible for pilots under the influence of liquor to even complete their pre-flight briefings with weather, dispatch, and mechanic personnel, let alone board their airplane for take-off. But we could not be sure that the public knew this.

The Board immediately engaged the services of the Yale School of Medicine which has a nationally known Alcohol Research Division to act as the Board's technical medical consultant in this case. In the meantime CAB investigators had raised the wreckage of the DC-3 from the bottom of the Bay and pointed out to the medical consultants that both tanks of de-icing alcohol—located behind the head of each pilot—were ruptured and emptied by impact force.

The Board's medical consultants rechecked the autopsy report, and by additional chemical analysis, proved that the alcohol found in the pilots' bodies was not drinking alcohol at all—but isopropyl alcohol which is poisonous and cannot be taken internally. In the meantime, our investigators had determined from company records that both de-icing tanks had been full at take-off—and that they contained isopropyl alcohol. It seemed probable that both pilots had inhaled quantities of salt water and alcohol from these tanks immediately following the crash and sinking of the airplane. However, the Board had to prove its case.

The doctors then performed numerous laboratory analyses, using live mice and drowning them in large tanks of salt water mixed with various amounts of isopropyl alcohol. By this method they were able to prove that enough alcohol from the ruptured tanks behind the pilots, when mixed with salt water in the immediate cockpit area, and inhaled, could result in the amounts of alcohol that showed up in the bodies of the two pilots. The Board was thus able to clear the reputation of these two fine men who died in the line of duty and to restore public confidence in the sobriety of airline operations.

Radio Message Aids in Solving Accident Causes

In another case following the fatal crash of a transcontinental airliner in Pennsylvania, the Board utilized medical consultants in another way to help determine the cause. In this case, several minutes before the crash, the pilot had radioed that his fire warning system indicated a fire in the forward baggage compartment—and he further stated that he had discharged CO_2 fire extinguishing chemicals into the suspected compartment. Thereafter, his radioed messages became slower, and hesitant and slurring in speech, finally trailing off into silence.

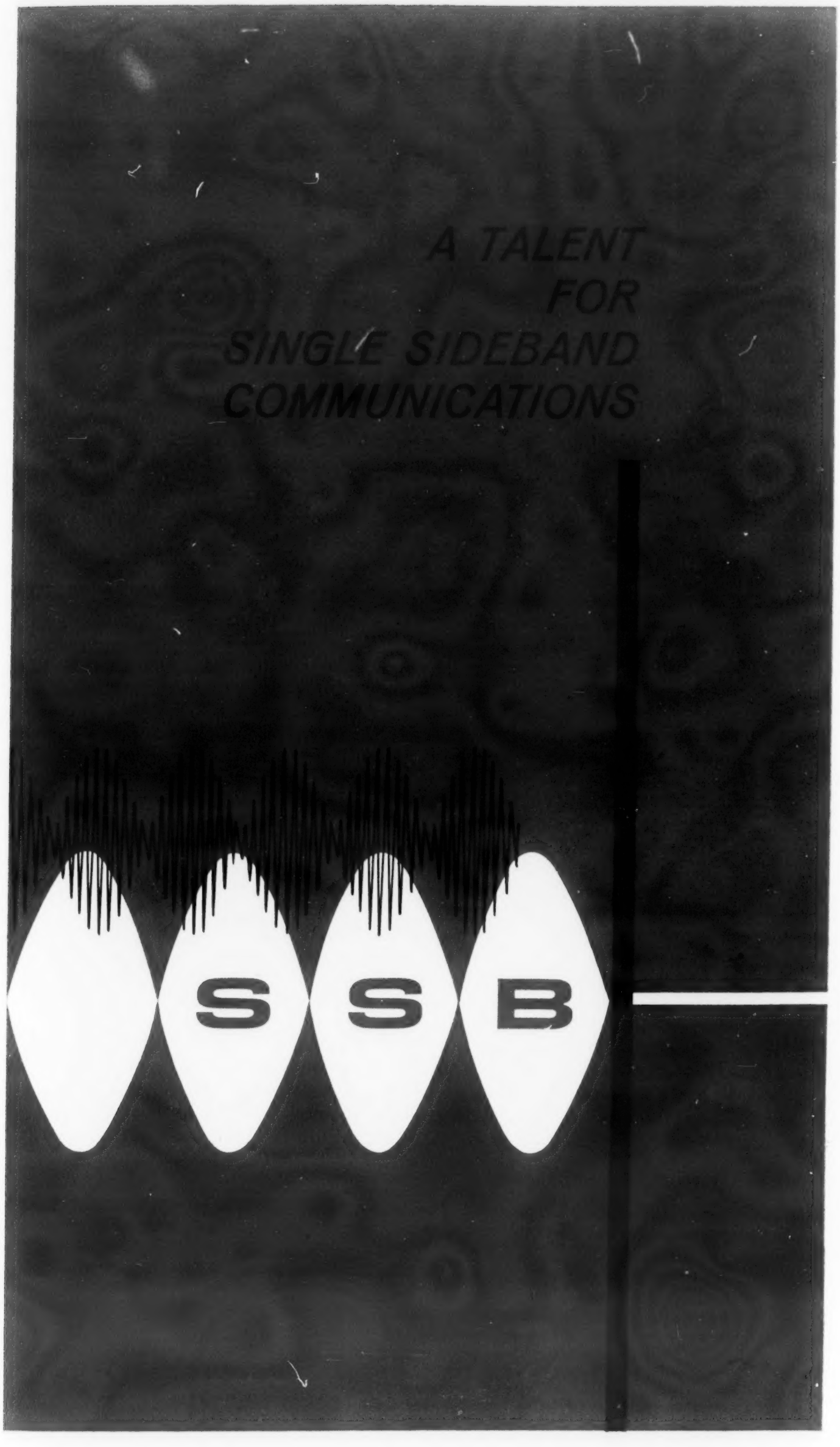
While the Board's investigators were combing the wreckage at the scene of the accident, other investigators proceeded to LaGuardia tower and impounded the automatic recordings made of the pilot's messages on the subject flight. The Board then took this master recording and had a phonograph recording company make several copies of the original radio message. These were then played back to medical speech experts at standard speeds but using increased sound volume in order to study the pronunciation and inflection of each word in the message. As a result of these studies, the medical speech consultants concluded that from the time of the first message to the last the pilot, without realizing it, was suffering from increasing anoxia. Therefore, it was concluded that he became unconscious—and probably the rest of the crew members and passengers—from toxic amounts of the CO_2 fumes he had discharged into the forward baggage compartment. This condition could have been brought about if the crew had failed to properly actuate the decompression system of the aircraft at the time of discharging the fire extinguishing chemicals. Subsequently, corrective measures were taken to prevent a similar accident from occurring again.

Widely different causes have been found by the Board to underlie most of the great headline air disasters of the last decade. But year by year the safety record of American air transport has improved; each year as the mileage flown increased, the fatality rate decreased, and for the past five years we have averaged less than one fatality per one hundred million miles of flight on scheduled U. S. flag and domestic air carriers. Indeed, in the calendar year of 1957, the record of one fatality per one billion passenger-miles flown was recorded—an unequaled international air safety record.

The work of the Board in aircraft accident investigation, plus the close cooperation we receive from all phases of the aviation industry, and with the assistance of outside scientific consultants and research facilities, has helped make air transportation the safest method of domestic travel in the United States today. And now, with all this experience behind us in the development and operation of piston-engined transport airplanes, we are preparing to apply this knowledge, and all of the technical foresight we can summon, to insure that the jet age of air transportation, will be the safest of all.

Sometime ago I enjoyed the privilege of visiting the five American aircraft manufacturers that are now engaged in the design and construction of jet-powered airline transports. Three of them are pure jets—the Boeing 707, Douglas DC-8, and the Convair 880. Two of them are prop-jet aircraft, with jet engines turning propellers—these are the 4-engined Lockheed Electra and the 2-engined Fairchild F-27. I was deeply impressed with the meticulous scientific care expended in evolving the design configuration and construction process of each of these airplanes. Moreover, before these jet transports attained their final certification and airworthiness certificates from the CAA, they successfully completed the most rigorous and extensive aerodynamic and flight testing programs ever conducted for commercial aircraft.

I believe that our new American jet transports will prove to be the safest public air carriers that the world of aviation has ever known.



Stromberg-Carlson is now developing for the Armed Forces . . . Advanced Single Sideband radio applicable to shipboard, vehicular and airborne communications.

The simplifying of both transmitting and receiving circuits in this digital-tuned radio marks a significant advance in Single Sideband reliability, economy and ease of operation.

Broad-banded circuits and a unique frequency synthesizer eliminate servo amplifiers and motors, discriminators and rate generators.

Heat-sink cooling eliminates blowers and air filters.

Brochure on request.

STROMBERG-CARLSON
A DIVISION OF **GENERAL DYNAMICS**
1400 N. GOODMAN STREET • ROCHESTER 3, N. Y.

introducing

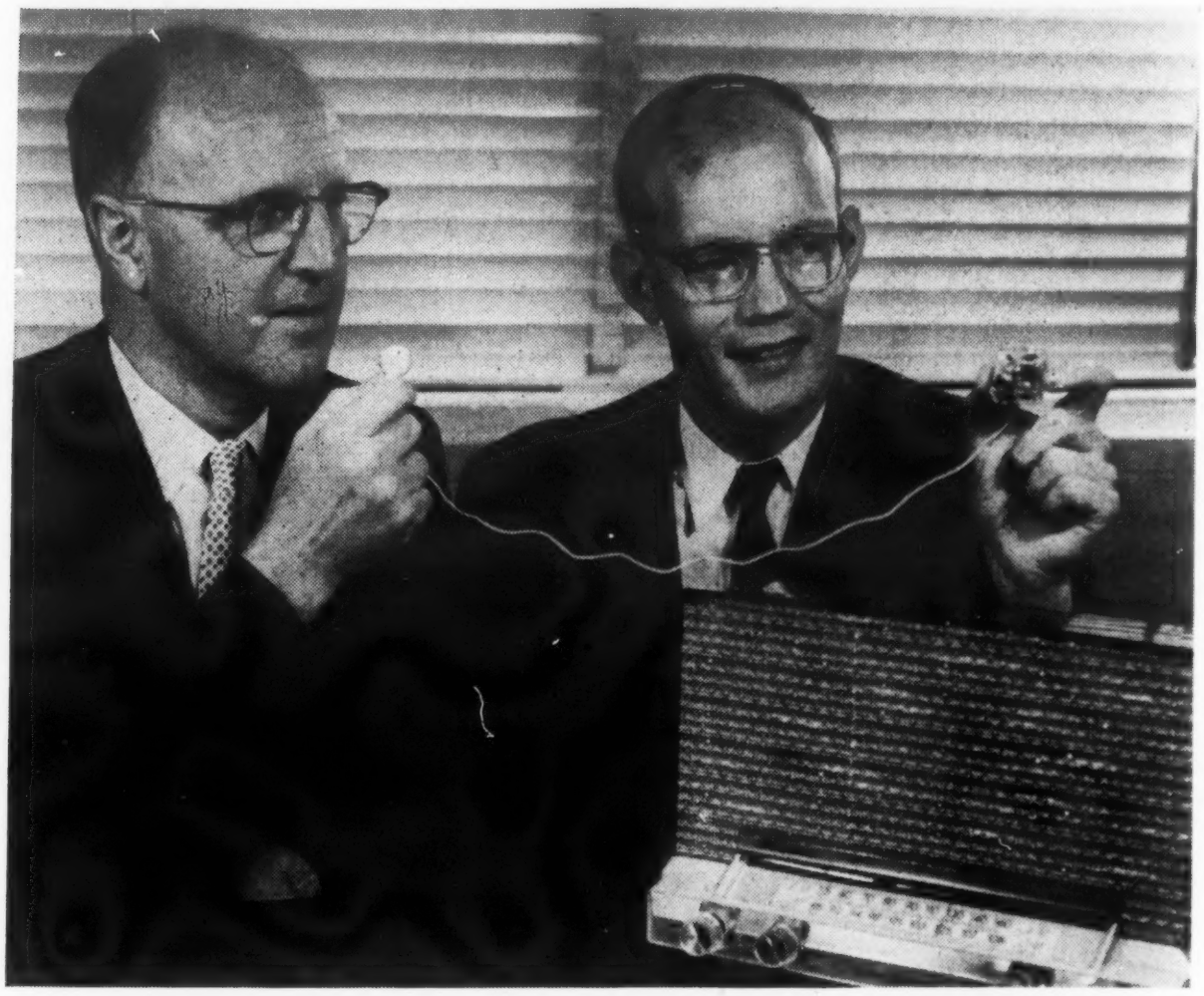
THE NEW TUNNEL DIODE

by

DR. MALCOLM H. HEBB
Manager
General Physics Research Dept.
General Electric Research Lab.

DR. JEROME J. TIEMANN
General Physics Research Dept.
General Electric Research Lab.

H. BRAINARD FANCHER
General Manager
Semiconductor Products Dept.
General Electric Co.



THE NEWEST "BABY" in the fast-growing family of electronic devices, the "tunnel diode," is coming of age. The new device, little over a year old, is both better understood and closer to commercial application according to Dr. Guy Suits, General Electric vice president and director of research.

The tunnel diode, first reported in 1958 by the Japanese scientist Leo Esaki, is a first cousin to a transistor, but operates on a different principle and offers advantages that the transistor does not. Before long it should find its way into high-speed computers, television sets, communication equipment, nuclear controls, satellites and space vehicles.

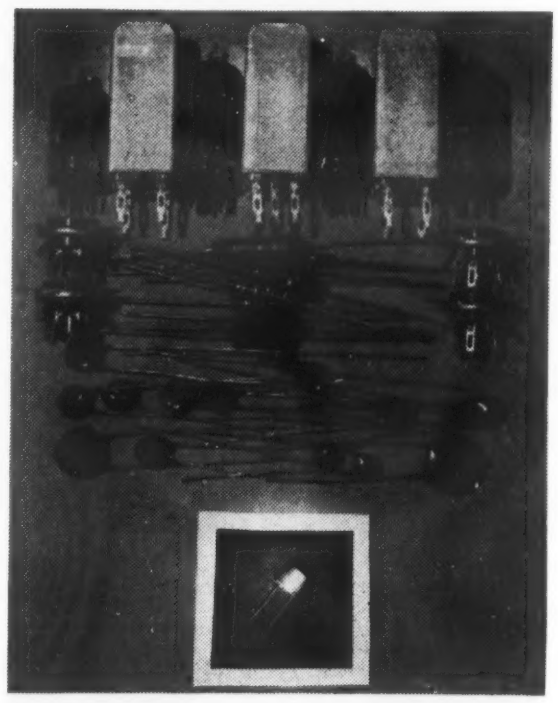
In introducing the tunnel diode, Dr. Suits said, "Because we were convinced that the tunnel diode could lead to revolutionary changes in the electronics industry, we launched and financed a concentrated research program on the subject. This has resulted in important new scientific understanding of the device, which has led to vastly improved tunnel diodes as well as a number of significant improvements in the field of applications.

"Further advances in the design and application of tunnel diodes can be expected, and it is probable that transistors and other solid-state devices will also benefit from the new knowledge."

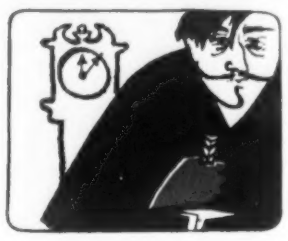
The improved tunnel diodes are still in the experimental stage and are not yet commercially available. However, to spur progress in circuit design, General Electric's Semiconductor Products Department now has plans to offer limited quantities of experimental samples for such use within the next few months.

(*Continued on page* 12)

(Above) Vest-pocket transmitter, making use of a tunnel diode, and with range of approximately one-half mile, is demonstrated by GE Research Laboratory scientists. Dr. Guy Suits, GE vice president and director of research, speaks into microphone as Dr. Jerome J. Tiemann holds the transmitter. In foreground, an FM receiver picks up the signal. (Right) Tunnel diode, bottom of photo, can perform simultaneously the following functions that are necessary in an FM receiver: amplification, oscillation, conversion, limiting, detection and automatic frequency control. If an FM receiver were rebuilt using a tunnel diode, all of the conventional components shown in the photo could be omitted, "although with some sacrifices in performance."



Star Performer



Actors often complain about restriction to the same type of role. It's easy to think of the man who always plays gangsters, the one never seen without a cowboy hat, and the fellow who can act nothing except romantic parts.

REL's unchallenged world leadership in tropospheric scatter equipment may overshadow REL achievements in other areas of specialized radio communications.

For example, another sector of REL preeminence is point-to-point apparatus, both long and short range. REL systems provide four to 240 voice channels, at frequencies from 130 mc to 2400 mc.

Among the special advantages available in point-to-point apparatus by REL are the patented, low distortion SERRASOID® modulator; the crystal mixer receiver, with its lower noise figure; and the same remarkable reliability developed for the rigorous demands of militarized tropo scatter (Specification MIL-R-9657A, USAF).

The point to remember in point-to-point communications is equipment by REL.

Radio Engineering Laboratories · Inc

A subsidiary of Dynamics Corporation of America

Dept. G · 29-01 Borden Ave · Long Island City 1, NY

REL

Creative careers at REL await a few exceptional engineers.
Address résumés to James W. Kelly, Personnel Director.

One of the most significant advances in scientific understanding of the device originated with some observations of mysterious "wiggles" in performance curves. These were first noted by Drs. Nick Holonyak, Jr. and Arnold Lesk at GE's Advanced Semiconductor Laboratory in Syracuse, New York. A theory that successfully explained the puzzling effect was subsequently worked out at the General Electric Research Laboratory in Schenectady, New York, by Drs. Jerome J. Tiemann, Robert N. Hall and Henry Ehrenreich.

The tunnel diode takes its name from the physical phenomenon that makes it possible: "quantum-mechanical tunneling." The term is used to describe the manner in which the electrical charges move through the device. Such motion takes place with the speed of light, in contrast to the relatively slow motion of electrical charge carriers in transistors.

The high speed at which electrical charges travel in the tunnel diode makes it possible for the device to operate at extremely high frequencies. Oscillation frequencies higher than 2000 megacycles have already been obtained, matching advanced transistor performance, and frequencies of more than 10,000 megacycles are expected in the near future.

The device's high-speed response also suggests applications in computers. When used as switches, tunnel diodes have functioned in a fraction of a milli-microsecond—from 10 to 100 times as fast as the fastest transistor.

The device also resists the damaging effects of nuclear radiation. Because it is less dependent on the structural perfection of its crystal than is the transistor, it is much less affected by the damage that radiation can do to such crystal structures. In this respect it outranks transistors by more than 1000 to 1. Semiconductors that have been used by GE scientists for making tunnel diodes include, silicon, germanium, gallium arsenide, gallium antimonide and indium antimonide.

The tunnel diode is smaller than a transistor and, because of a simpler structure, ultimately will be a small fraction of its present size. It also is affected little by environmental conditions. Silicon tunnel diodes made by General Electric work at temperatures as high as 650°F; conventional silicon diodes will not operate above 400°F.

As an electrical circuit element, the tunnel diode exhibits a unique combination of electrical properties including what is called a "negative resistance" over part of its operating voltage range. These characteristics allow it to be used in a wide variety of applications, such as an amplifier, a generator of radio-frequency power and a switching device. The simplicity of this device makes possible the development of "integrated circuits," in which entire circuits for some applications may be formed on a single semiconductor structure. It is superior to vacuum tubes and transistors for applications in low-noise amplifiers and mixers for high frequencies. Many parametric amplifier jobs, for example, could be performed more easily by tunnel diodes.

Editors Note: The following three presentations will give SIGNAL *readers further insight into the new tunnel diode.*

Dr. Hebb

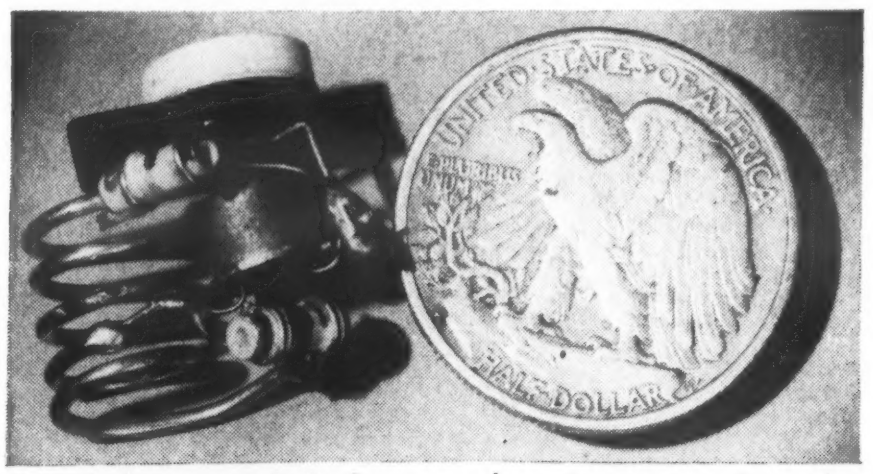
THE TUNNEL DIODE is the most important advance in semiconductor devices since the transistor. We in General Electric are now in a position to report that we have improved tremendously tunnel diodes and have greatly increased their versatility. Improvements in tunnel diodes suggested new applications, and new applications demanded even better diodes. More importantly, the improved diodes made possible measurements of more fundamental significance and led to a better scientific knowledge of how the new, formerly mysterious, devices actually worked. This new knowledge, in turn, led to the vastly superior tunnel diodes that I cover in this presentation.

The principle of operation of the tunnel diode, which was partially interpreted by Esaki, is radically different from that of transistors, rectifiers, ordinary diodes and other semiconductor devices. The potentialities of the tunnel diode were not generally recognized at first, and no great notice was taken of Esaki's announcement. Moreover, much of the behavior of the tunnel diode was simply not understood.

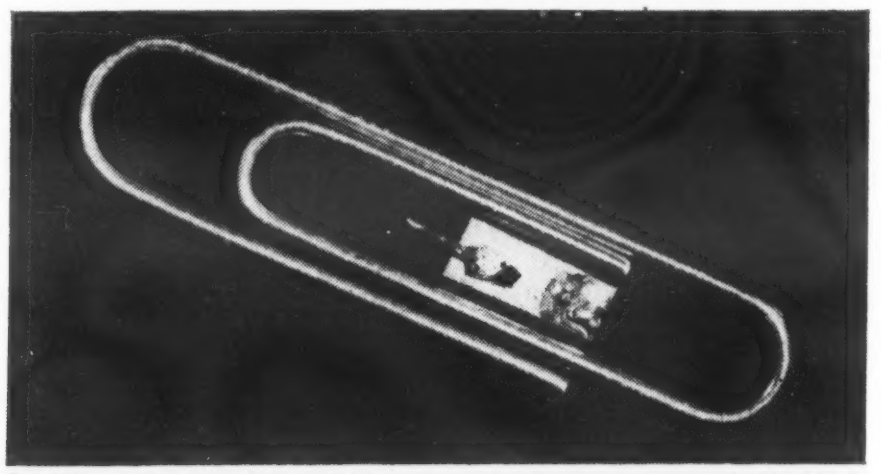
The name "tunnel diode," as Dr. Suits explained, comes from the physical phenomenon of "quantum-mechanical tunneling," by which electrons are able to get across the junction region of the diode. In the transistor one has a simple picture of an electron starting from the emitter and diffusing across the base region to the collector. In the tunnel diode, on the other hand, there is no such classical picture. One must somehow imagine that the electron can "jump" from one side of the junction to the other without being in between. While the ordinary motion of electrons in semiconductors is relatively slow, electrons tunnel across the diode at the ultimate speed—the speed of light. This is one of the reasons that there is so much interest in the tunnel diode: Because it functions at the speed of light, it can be the ultimate in fast-acting or high-frequency devices.

The objective of the General Electric scientists was to lay the foundation for the practical application of the tunnel diode. It was first necessary to explore many different ways

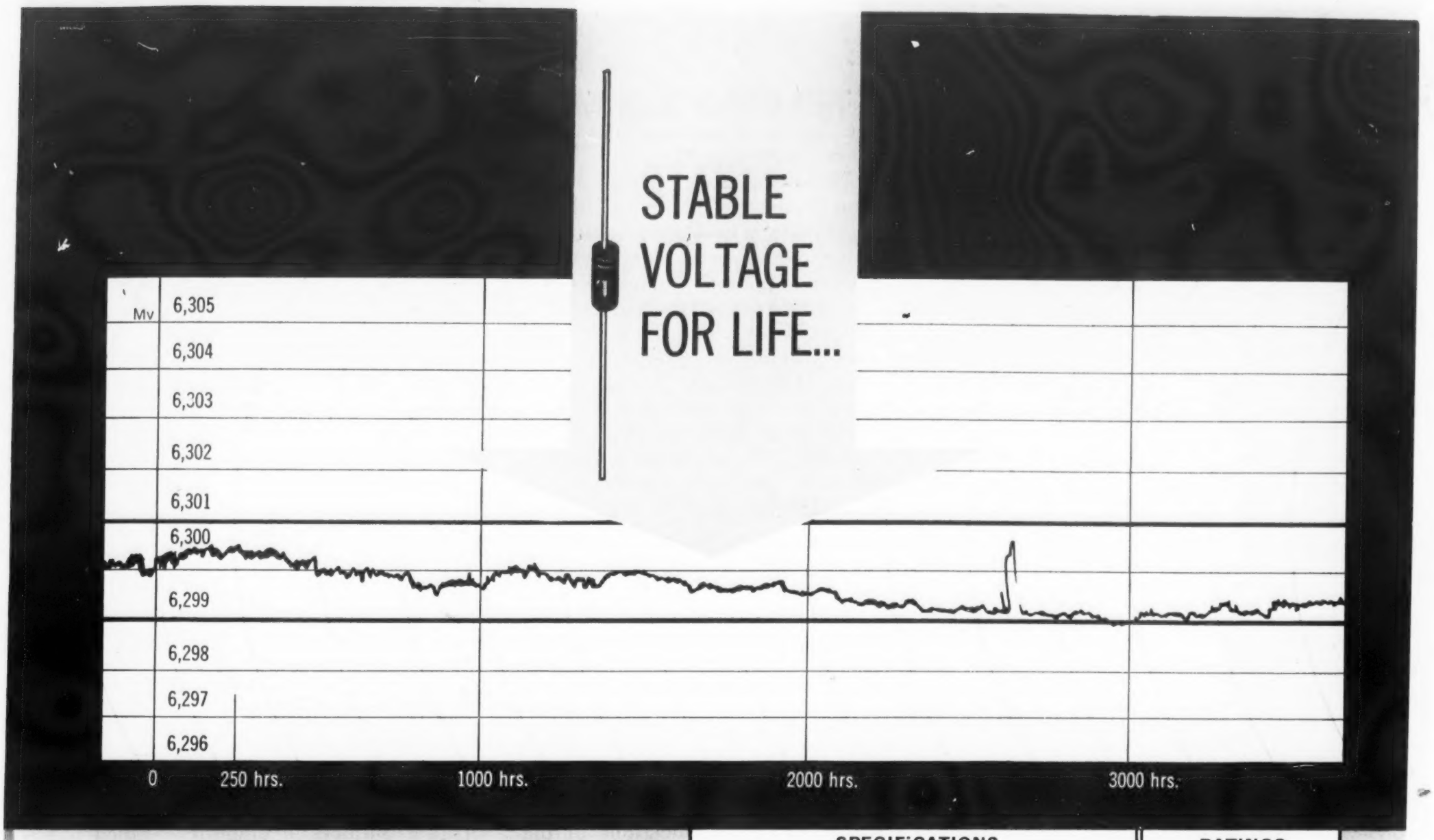
(*Continued on page* 14)



A complete tunnel diode transmitter is compared in size with a 50-cent piece. The transmitter consists of one variable and two fixed ceramic capacitors, a coil that tunes to the operating frequency—which may be higher than one kilomegacycle per second—and the tunnel diode itself, located inside the "can" in the center of the device.



Inside a paper clip, with room to spare, a tunnel diode is shown in close-up view. The connecting wire (left end) leads into an alloy, which is soldered to a germanium crystal (dark area). The crystal, in turn, is soldered to a rectangular metal plate, which constitutes the other connection.



STABLE VOLTAGE FOR LIFE...

NEW ULTRA-STABLE ZENER DIODES

Type	SPECIFICATIONS: Voltage Range at I_Z = 7.5 ma at 25°C (Volts) Min.	Max.	Temp. Coefficient[2] (−55°C to +100°C) at I_Z = 7.5 ma (%/°C)	Maximum Dynamic[3] Resistance at 25°C at I_Z = 7.5 ma (ohms)	RATINGS: Operating and Storage Temperature Range (°C)	Max. Operating Temp. at I_Z = 7.5 ma (°C)
1N821	5.9	6.5	±.01	15	−65 to +150	+125
1N822[1]	±5.9	±6.5	±.01	15	−65 to +150	+125
1N823	5.9	6.5	±.005	15	−65 to +150	+125
1N824[1]	±5.9	±6.5	±.005	15	−65 to +150	+125
1N825	5.9	6.5	±.002	15	−65 to +150	+125
1N827	5.9	6.5	±.001	15	−65 to +150	+125

[1]Double anode types.
[2]Determined by measuring a change of voltage from −55°C to +25°C and a change of voltage from +25°C to +100°C.
[3]The Dynamic Resistance is measured by superimposing a small A.C. Signal upon the test D.C. Current. (I_{AC} RMS ≤ 1/10 I_{DC} Test)

1N822 and 1N824 types meet all specifications, including temperature coefficient, in both directions.

This new line of subminiature silicon voltage references features a combined lower dynamic resistance and voltage stability exceeding that of *any* standard cell.

Manufactured by diffusion, these devices offer temperature coefficients as low as 0.001% °C. Unique single piece construction enables the reference to maintain excellent voltage stability when subjected to severe thermal shocks. Axial lead design and hermetically sealed glass encapsulation insure a rugged unit capable of providing long term reliability over wide ranges of environmental conditions.

These new subminiature references are also available in double anode types for symmetrical clipping applications.

Send for bulletin TE-1352.

Select from the nation's broadest line of regulators and references, including these types:

Rating	Type Number
250 MW	SV5 – SV24
250 MW	1N708 – 1N745
400 MW	1N746 – 1N759
750 MW	SV804 – SV824
1 WATT	1N1765 – 1N1802
10 WATT	SV904 – SV924

Contact your nearest authorized Transitron industrial distributor for in-stock quantities 1-999.

Transitron ®

electronic corporation • wakefield, massachusetts

"Leadership in Semiconductors"

Tunnel Diodes

(*Continued from page* 12)

of making tunnel diodes and to discover how to improve their characteristics.

One of the more important characteristics of these versatile devices is the negative resistance region of the current-voltage curve. The negative part of the curve should be as steep as possible for best performance in oscillators and amplifiers. The ratio of currents at the peak and valley should be large in order to minimize power requirements. For microwave frequencies, the capacitive reactance of the diode must be kept small in relation to the negative resistance. For application as a detector, the curvature of the current-voltage characteristic should be high. All of these properties can be attained by the fabrication of the tunnel diode and the elements of which it is made.

The second line of activity that we have pursued is the incorporation of tunnel diodes in novel circuits to perform different functions. These have included oscillators, amplifiers, mixers, detectors, computer elements, and temperature and voltage sensors. This is an extremely exciting area to think about, since it gives a glimpse of the many applications for the future.

But the third area of our work is perhaps the most important for the future. The basic phenomenon of tunneling has been known for a long time and is well understood. However, its existence in semiconductors is comparatively new, and the behavior of the tunnel diode, as I have said was a puzzle. Past experience has shown that we are never able to realize the full potentialities of any physical phenomenon until we understand it quite thoroughly. It was therefore a significant part of our objective to unravel and interpret the measurements on tunnel diodes in a fundamental way. I am happy to report that we have made progress in this direction.

The first break came when our scientists, while experimenting with tunnel diodes at the temperature of liquid helium, found some pronounced differences between the current-voltage characteristic at this temperature and the current-voltage characteristic at high temperatures. An unexpected result such as this is a challenge but also an opportunity for, if it can be explained, it will give additional insight into what is going on. After considerable conjectures and attempted verification, the correct explanation was evolved, and proven. The new features which our scientists uncovered were cusps in the current-voltage curves. Their explanation of these new features can be summarized in the following way. Whenever an electron "tunnels" in the diode it must generate a little sound wave or vibration of the semiconductor crystal, called a phonon. Since this requires extra energy, the current increases suddenly when the voltage is able to provide the energy for the phonon. This is the most direct demonstration so far, of the interaction between electrons and phonons. For example, the voltage at which the cusps occur gives the energy of the phonon directly, and the size of the current increase is related to the strength of the interaction between the phonons and electrons.

This knowledge is likely to have repercussions on many areas of solid-state physics and will, with little doubt, lead to improvements in other semiconductor devices.

Dr. Tiemann

DR. HEBB has told you a little about the possible applications of the improved tunnel diodes made by my colleagues and myself. I would like to elaborate a bit on this subject and tell you which aspects of the tunnel diode are the most important ones for the various fields of application.

Generally speaking, the important properties of tunnel diodes from the electronic-circuit viewpoint are:

1. Extreme speed (high frequency).
2. Stable characteristics that are insensitive to temperature changes.
3. Modest power supply requirements.
4. Ability to operate in a wide variety of critical environments.
5. Low noise level.
6. Simplicity—light weight—small size.

These features indicate that the tunnel diode will find many applications in a large number of fields.

One of the most important of these fields will be high-speed digital computers. The reason the tunnel diode is important in this field is its high speed of response when made to operate as a switch. The tunnel diode switches either on or off in a fraction of a millimicrosecond.

The important thing here is that the switching can occur so fast after the input pulse has been received. The low output voltage of the tunnel diode may appear to be an inconvenience and, in some respects, it is. This, however, may turn out to be a blessing in disguise.

I say this because the low voltage means that tunnel diodes do not generate much heat, and one of the most difficult problems which plagues computer engineers is how to get rid of all the heat. As people try to pack more and more computer in a smaller and smaller space, the problem of heat dissipation becomes even more severe. The tunnel diode may offer some help in this respect, since it can be made to consume far less power even than a transistor, which in turn uses much less than a vacuum tube.

Radio Communication

Another field of application is radio communication. Here the tunnel diode is important, first because of its high-frequency potential and excellent stability, and also because of its ability to operate in critical environments with modest power supply requirements. As an extra bonus, it turns out that the tunnel diode has excellent low-noise properties. At present it is surpassed in this respect only by the maser—which requires bulky refrigeration equipment—and by the parametric amplifier—which requires a high-frequency oscillator (generally a klystron) in order to operate. In contrast, the tunnel diode needs only a simple direct-current supply.

Because of the auxiliary equipment needed for an amplifier employing parametric diodes as masers, the overall power consumed by these systems is over a million times as much as would be required by the tunnel diode stage. Even after one has added in the power required by subsequent stages in a receiver, which would be common to any system, the simplicity of the tunnel diode may prove to be such an advantage that it will find use in airborne or satellite communications equipment despite its slightly noisier performance.

We have, via experiments, demonstrated how the tunnel diode's characteristics can be exploited, through novel circuit design, to produce a variety of functions from one diode that would require a large number of conventional components to duplicate. The important idea here is that the tunnel diode is a new and different component with a unique combination of electrical properties. It happens that these characteristics make it the proverbial square peg for quite a number of square holes. Tunnel diodes will also find application as local oscillators for superheterodyne receivers, as amplifying mixers and detectors, and in low-noise preamplifiers for high-frequency receivers.

(*Continued on page* 26)

Today's smallest two-way mobile radio - actual size!

New General Electric Transistorized Progress Line

General Electric's new Transistorized Progress Line will fit in more places, in more different positions, than any other two-way mobile radio you can buy today.

Not only is this the world's smallest, lightest commercial two-way mobile radio, but standby battery drain is so low you need never turn off your TPL mobile unit, just like the clock in your car. You install no special generator, use less gas, require fewer engine jobs.

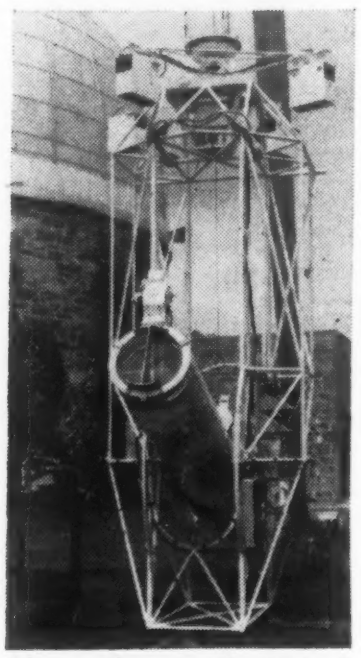
TPL is the first two-way radio that transmits up to 75 watts of power in high band . . . the first that really fits under the dash . . . the first to realize the full benefits of transistorized design (no more than four tubes) . . . the first to eliminate bulky cables through new one-piece design of receiver control and transmitter . . . the first with shielded dirt-free ventilation.

The new General Electric TPL ushers in a new era of convenience and reliability in mobile communications. Don't miss all the exciting details. Write General Electric Company, Communication Products Department, Section 43109, Mountain View Road, Lynchburg, Virginia.

GENERAL ELECTRIC

Communication Products Department

STRATOSCOPE 1



Shown above is the 12-inch solar telescope which was carried into the stratosphere by balloon to make photographs of the Sun.

by
S. E. HOOD
SIGNAL Staff

IN THE MIDST OF ALL the atmospheric traffic of jet aircraft, rockets, missiles and beeping space satellites, the balloon floats serenely and silently on its way to prominence as an invaluable vehicle of space research.

Since the days of Galileo, astronomers have been hampered in their studies of the heavens by the earth's atmosphere which obscures clear visibility of celestial objects. Twinkling starlight is lovely to behold and has been described frequently in beauteous terms by poets. The astronomers, however, merely describe the scintillating asteroid as "bad seeing." The air between a ground telescope and space is heated unevenly and disturbance is caused by the wind, particularly near the ground and in the tropopause, or jet stream region, a turbulent layer at 40,000 feet. This turbulence causes the "bad seeing." It is not possible to distinguish separate stars if they are close together or to make out fine details on large objects, such as the Sun. Even under the best atmospheric conditions the 200-inch telescope of Mt. Palomar can rarely distinguish between two points on the Moon's surface less than 1800 feet apart, while it could distinguish between points only 120 feet apart if it did not have to peer through the Earth's atmosphere.

Thus, the balloon has long been an obvious means for making astrophysical observations. It can rise above the troublesome atmosphere and requires no fuel for flight. It can be made of inexpensive plastic materials and thus will not expand as do rubber balloons and will therefore float naturally at a pre-determined density altitude. The scientific measurements taken by balloons are far less influenced by acceleration and vibration than those taken by a vehicle hurtling through the air at high speeds. It becomes a working laboratory high above the earth.

The Office of Naval Research (ONR) has been pioneering in both manned and unmanned balloon astronomy flights for several years. In 1946 ONR inaugurated its upper atmosphere research program by exploring the balloon as a vehicle for providing a stable platform for scientific observation. A contract was awarded to the newly established Aeronautical Research Laboratory of General Mills, Inc., to design and construct balloons made of a thin plastic material. In 1956 ONR awarded a contract to the Princeton University Observatory for the construction of a 12-inch telescope, a camera and a guidance system suitable for carriage by an unmanned balloon. The Air Force Cambridge Research Center joined ONR by providing financial assistance for this solar instrumentation. Dr. Martin Schwarzschild, a Princeton University astronomer who had proposed the unmanned balloon-telescope- camera, was made scientific director of the project which came to be known as STRATOSCOPE.

The first Stratoscope flight was launched September 25, 1957, from the General Mills Flight Center, New Brighton, Minnesota. The Stratoscope I balloon remained at an altitude of 82,000 feet, above nearly 96% of the Earth's atmosphere, for three hours and forty-five minutes. A second flight on October 17, 1957, was launched from Huron, South Dakota, and reached an altitude of 83,200 feet. These 1957 flights resulted in the first successful attempts at high altitude astronomy. The special Sun telescope camera took photographs of the Sun's surface which were unprecedented in clarity and detail. For the first time the detailed polygonal structure of the convective currents ("granulations") that bring much of the internal solar energy to the Sun's surface was shown.

Stratoscope Telescope

On July 11, 1959, Stratoscope I began its second series of flights with a balloon launched from Lake Elmo, Minnesota. This time a closed-circuit television camera and remote control equipment made the trip, too. Ground observers were able to watch the area being observed by the telescope and could point the instrument at any region of particular interest, such as a Sun spot.

The Stratoscope telescope is a 12-inch aperture system with a focal length of 2400 inches. Its f/8 paraboloid quartz primary mirror has a surface that does not depart more than one millionth of an inch from a parabolic curve.

Ground observers can point the telescope by means of sensitive photodiode "eyes." Signals from the "eyes" go to an amplifier and through a power supply to drive motors which move the telescope in azimuth and elevation. The 35mm camera installed into the telescope has a frame size of 1 x 1½ inches exposed which is roughly equivalent to 0.5% of the Sun's area, or 50,000 by 75,000 miles. The camera can take 8,000 photographs at a rate of one per second.

The television system includes airborne camera, transmitter and antenna units and a ground-based assembly comprised of a receiver and three special monitors. The system possesses a slow scan rate of one

(*Continued on page* 20)

TEAM POWER

New weapon in the Air Force arsenal

The mightiest of air powers, the United States Air Force, has added a new kind of weapon to its arsenal—*teamwork* of private industry.

Defense of the free world requires unprecedented scientific achievements—new weapons systems so advanced they demand the specialized capabilities of many organizations.

The Air Force was first to utilize the great creative power available in the *combined* abilities of private industry—the TEAM concept. This Air Force partnership with industry has resulted in today's highly successful *Project Level Systems Management.*

Recently the specialized talents of eight organizations were joined together by Hoffman Laboratories Division as systems manager in developing a complex electronic reconnaissance system for the Air Force. The success of this program is proving the value of combining the talents of several companies to meet the requirements of today's complex weapons systems.

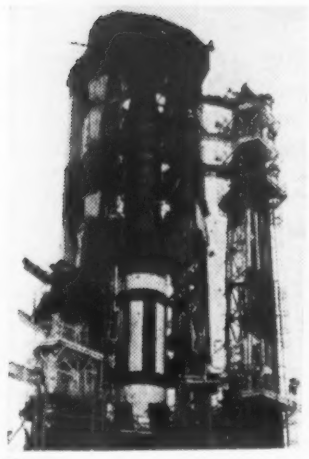
This kind of teamwork transforms healthy competition into powerful cooperation . . . providing better answers faster and at less cost to the nation in terms of time, money, and manpower.

Hoffman Electronics
CORPORATION

HOFFMAN LABORATORIES DIVISION / 3740 South Grand Avenue, Los Angeles 7, California

Missile Support Equipment • Radar • Communications • Electronic Countermeasures • Navigation
Semiconductor Applications • Electro-Mechanical Equipment • Weapons Systems • Field Services

Significant developments at Hoffman have created positions for scientists and engineers of high calibre. Please address inquiries to Vice President, Engineering.



Titan

Thor

SAFETY INSTRUMENTATION FOR TACTICAL MISSILE RANGES

by
COLONEL C. W. GIBBS, USA
U. S. Army Air Defense Center
Fort Bliss, Texas

IN THIS ARTICLE, some range safety problems which are unique to the tactical missile range will be discussed and some tentative solutions which are being worked out to increase range safety at the largest tactical missile range in the U. S. will be described in some detail. It is hoped that the shortcomings of these solutions will be illuminated by future writers and studied by the range safety specialists with the same beneficial effects as have accrued from the concentration on R&D type range safety problems.

When a Missile Becomes Tactical

As long as a new type missile is under development and test, it is usually undergoing changes and improvements which in themselves are glamorous because they represent scientific achievements and in some instances major breakthroughs in the state of the art.

Usually by the time a missile is turned over to the tactical troops, its merits (and demerits) have been discussed in the press to the point where the missile's performance and reliability are an established fact in the public mind. And indeed by the time the troops get their hands on a missile for tactical use, it has been subjected to every test under the sun to make it just as safe as is humanly possible. All but the most infinitesimal "bugs" have been ironed out and the bird has many classified interlocks and built in safety devices which are so ingenious as to make a missile practically 100% foolproof.

But regardless of how safe we get the missile itself and regardless of how far out in the "boon docks" we establish missile ranges, some of the safety factors still must operate. Any time a large hunk of hardware like a missile is hurtled through the air anywhere in the U.S.A. at speeds of Mach something or other, we have a basic safety problem when viewed from the viewpoint of the safety officer at the launching area.

Odds are in Favor of Tactical Safety

And remember, that mathematically at least, the chances for accidents increase as the volume of missiles fired increases.

Operating to counter these unfavorable mathematical odds on the tactical range is the intensive training and years of experience of the missile crews themselves. And the relatively few soldiers with only a small amount of training or experience tend to increase the safety from the standpoint of human error for two reasons: (1) They operate entirely according to a step by step check-out and launching procedure with built-in safeguards and with experienced leaders looking over their shoulder; and (2) They are simply scared to take any chances on making a mistake after they have seen their first missile fired at close range!

McGregor Tactical Missile Range

From the standpoint of volume of fire, McGregor Guided Missile Range of the U. S. Army Air Defense Center is easily the largest tactical range in the U. S. and probably in the world and is continuously increasing this volume.

It is referred to here as a "tactical" range only to distinguish it from the R&D type ranges such as the fully instrumented White Sands Missile Range which is operated by the Chief of Ordnance for the Army, Navy and Air Force contractors who are developing and firing multitudes of missiles under Government contract. Although McGregor and White Sands Missile Ranges are side by side on opposite sides of New Mexico Highway #54 north of El Paso, their missions are completely different and also their safety problems, and hence safety instrumentation requirements are also very different.

McGregor, as a tactical range, has only the fundamental safety problems inherent in any restricted area where high altitude, high speed missiles are fired. It needs none of the sophisticated instrumentation such as camera theodolites, speed measuring telemetering systems, and temperature or vibration devices which are a must on an R&D range such as White Sands. By comparison with the R&D type range, McGregor's safety instrumentation requirements are pretty austere. But it is still necessary to keep the missiles on the range and within safety limits and to know where all air vehicles in the vicinity are with respect to McGregor. Since there are approximately 30 missile launchers sitting side by side with a central safety control tower overlooking the McGregor launching area, an immediate problem presents itself. How to keep track of the status of 30 launching systems in varying states of readiness to fire and insure orderly safety clearances of all?

Fire Control Console

This will be accomplished by a missile safety control console designed by Air Defense Center personnel at Fort Bliss and now under construction in the Signal Division of the Fort Worth General Depot. This console will visually display the status of each missile on the 30 launchers by means of colored lights on the console panels. The McGregor safety officer can transmit "hold" or "fire" orders to any one of the 30 launchers by means of a simple push button (red or green), underneath the signal lamp for each launcher. He is also in continuous intercom voice communication via loud speaking "squawk

boxes" with stations at all key points such as drone target launchers, missile launchers and subordinate safety control officers.

In addition he is in constant touch both visually (by means of colored status lights) and orally-with the G-3 (operations) range safety control center which exercises over-all safety surveillance of all ranges in the Air Defense Center complex. The complex includes Dona Ana Range, Hueco Range, Oro Grande Range and McGregor Missile Range. The G-3 range control is in continuous touch with safety officers at White Sands Missile Range and with CAA safety officers at International Airport and at Biggs Air Force Base (SAC), both of which are nearby.

New Microwave System

Programmed recently for installation is a range safety microwave system (Project FIESTA) which will be controlled from the central control tower at McGregor Range. Out stations of the Air Defense Center Range complex will be located at Oro Grande, White Sands, Dona Ana and Fort Bliss. This system will provide a safety capability not presently available over the Fourth Army wire system. That is the capability to remote radar scopes into McGregor tower from such locations as White Sands and the US CONARC Air Defense Board's Site Monitor north of El Paso. Remoting radar scopes from long range radars which are in position to "see" McGregor as they scan the skies from White Sands and Site Monitor provide complete radar coverage of McGregor and increase range safety without duplicating existing radar installations.

Video Capability

And of course a microwave system opens up the possibility of handling TV video as well as the radar video mentioned above and other broad band safety signals already available from existing instrumentation on other ranges, thus saving the expense of duplicating the instrumentation at McGregor in order to insure maximum safety.

The TV video capability afforded by the microwave will also allow the Air Defense Board to completely integrate its various missile system tests with the Missile Monitor tests now underway in support of the Chief Signal Officer's MSG-4 systems tests program being conducted by the Board. TV transmission capability also will provide for the first time the bandwidth necessary to operate closed circuit TV between the several missile ranges and the classrooms of the Air Defense School. This will enable savings in time and transportation of students from the school area in Fort Bliss to the McGregor launching area to observe missile firings.

This closed circuit TV capability of microwave is as any voice channels derived therefrom, a by-product of the range safety microwave system which can be realized at little extra cost after the basic RF portion of the range safety microwave terminals are in operation.

The third safety feature required at McGregor range to provide accurate spacial position data on some missiles of the present and future systems is a simple telemetry type system. This is required for the safety of systems to be integrated into the McGregor firing load in addition to the surface-to-air systems now being fired there. Such a system is currently planned and will become operational as soon as is feasible. When it is completed, it will be possible to accurately determine the position of any kind of a missile in flight even if all other ground means of communicating with it are inoperative. This will provide the tactical missilemen with a dependable, positive means of insuring range safety by determining the exact route and spacial position of a missile even though it may present too small a target to reflect adequate size radar signals. For example, a radar looking at the tail end (diameter less than 12 inches) of a missile traveling down range at a low altitude and at high speed does not present much reflective surface to a radar at the McGregor launching area. Additional range safety can be provided by simply placing a flea-power telemetry type transmitter aboard the missile and some ultra sensitive receivers at known distances and azimuths from the launchers.

With these three basic additions to the fixed communications and launching facilities, it will be possible to carry out the range's expanding mission of teaching new units to fire missiles and keeping the "on site" units of ARRADCOM and foreign based units in a high state of proficiency by Annual Service Practice (ASP).

As present, McGregor is the site of training of all NATO type surface-to-air missile units in the free world. Range safety is the watchword of the tactical missileman but he has outgrown the limited tactical safety equipment included in the TO&E (tables of organization and equipment) of an on site missile unit. Therefore, as McGregor expands and volume of fire increases, he is being supplied with fixed type safety equipment to supplement his overtaxed TO&E gear, which was never intended to be used in a cluster of 30 or more fire units and their launching facilities anyway.

His tactical communications and safety training with organic equipment is not being neglected since his ultimate mission is "on site" and his unit must be completely mobile when firing from any locality in the field army. During the period while a missile troop package or an on site unit is firing at McGregor, he will be able to take all safety measures demanded by the locale and special safety factors at McGregor range in his stride. And he can be seen doing it by students in classrooms 20 miles distant, via closed circuit TV (when TV is available).

Although McGregor's tactical troop training mission may not appear as glamorous as the R&D type missile ranges, it nevertheless has the many faceted responsibility for the army's most valuable asset—the soldier-missileman.

To insure that he has the basic safety tools necessary for tactical range safety, Project FIESTA (which is the name given to the new microwave project) was given top priority and the first increment of the system is now on the air.

Those of us at the Air Defense Center who have participated in the concept and early development stages are acutely aware of the capabilities of the electronics industry to solve range safety problems of all kinds. In fact, the entire project is an outstanding example of the military-industry cooperation to produce even unique range instrumentation with short deadlines and do it on a "turn key" basis at minimum cost to the Government.

PART II

Much has been written about missile range instrumentation. A rapidly growing specialty within the broader field of range instrumentation is *range safety* instrumentation. This specialization is readily understandable when we consider that: a. Most missile ranges are near some populated places. b. Most missile ranges must fire missiles which are in the research and development stages. c. Missiles which are in the experimental and test stage are inherently more dangerous before they have had the bugs worked out of them.

(*Continued on page* 42)

Stratoscope

(*Continued from page* 16)

picture per second in contrast to the 30 pictures per second of standard broadcast television. This provides ground viewers with all the information required and permits the use of simplified low-power airborne equipment operating within a narrow frequency band. Together, the transmitter and camera require only 76 watts of power and the transmission requires only a 200 kilocycle bandwidth, 1/20 that of the 4-megacycle bandwidth needed for broadcast television.

Two of the monitors are used for direct viewing. They present the transmitted images on 7-inch screens and employ an orange phosphor which retains the image in bright form during the slow scanning process. The third monitor records photographs as a later check against the motion picture film of the camera mounted on the telescope.

Impressive Results

The July balloon reached an altitude of 81,800 feet and obtained some of the clearest photographs ever taken of sun spots and the magnetic area near sun spots. Another flight on August 17, 1959, was described by Dr. Schwarzschild as completely satisfactory. The data obtained from the photographs is being carefully analyzed by Stratoscope astronomers. The photographs have revealed more structure on the Sun than anticipated. The 1957 results have made important contributions to the knowledge of how heat produced at the center of the Sun is carried outward. Information about conditions in the interior of the Sun should aid astronomers in understanding the evolution of stars in general.

The Office of Naval Research and the National Science Foundation, who joined ONR in sponsoring the Stratoscope I flights of 1959, are already making plans for Stratoscope II, a 36-inch telescope, to be flown in 1961. They plan to examine objects other than the Sun, such as the planets, galaxies, and nebulae. Balloon research with both Stratoscope I and Stratoscope II will be of assistance in the development of techniques required for an unmanned satellite observatory. The research should also aid in the understanding of a variety of problems of astronomy, such as the controversial features of Mars, the topography of the Moon, the detailed structure of the Crab Nebula and the structure of the colliding galaxies in Cygnus.

Electronics Looks Ahead

(*Continued from page* 5)

Millions of dollars are spent every year on product research without anyone asking the question: Is there a market for this product if it can be developed? Or, if there isn't a market, can a market be developed and at what cost and how? These questions should be asked and answers should be developed before these large sums are expended.

This would result in a happier situation for the technical people, because then they would see their ideas utilized, and for a more profitable operation for the company.

A recent study by Stanford Research Institute found that more than one-third of the high growth companies maintain strong market research groups; less than 10 percent of the low growth companies have this capability. There is a strong relationship between marketing research and company growth.

I believe that to evolve our over-all marketing problem we will have to act collectively as well as individually within our own companies. Perhaps, many communication and electronic organizations have already explored the possibility of working with our colleges and universities to get more men trained in marketing procedures. The requirement for marketing men in this new field is unique. They must be market-oriented technical men in order to be able to serve effectively as liaison between management, production and the potential customer. Finally, I would like to propose that those of you with interest in communication and electronic organizations, create a special marketing award for non-military products, recognizing outstanding achievement in this field the same as is done in the scientific field. It is time we recognize marketing as a profession.

I believe that by recognizing marketing talent and by making marketing a key function in our forward thinking, we will be unleasing a new and powerful force in our economy, one that will help push our gross national product to the $700 billion level by 1970.

Conclusion

In conclusion I would like to reemphasize the importance of improving communications between our scientists and marketing people. It should be the responsibility of our scientists to educate our marketing people as to what can be done, and it should be the responsibility of our marketing people to educate the scientists on what is needed.

We are a big industry now. I remember a few short years ago when WESCON consisted of 25 exhibits in the Elks Temple; today there are 960 exhibits. Our industry will continue to grow. Our actions will have a greater and greater effect on our economy and on our society. Our responsibilities will increase.

I believe that as an industry we also should begin to think bigger. Consider, as a starter, the many problems created in the first half of the 20th century by our rapid industrialization. Perhaps we should begin to devote the second half of the century to solving them. Air pollution, unnecessary death on our highways and airways, the over-population of our radio spectrum, these are only a few of the man-created problems that cry for attention.

While we are still young, as an industry, let us direct our tremendous vitality and knowledge to fulfilling the promises of the future. Civilization's greatest need, in my opinion, is for low-cost water and energy. A breakthrough leading to the economical mass conversion of salt water into fresh water, is badly needed.

Medical electronics, still in its infancy, holds great promise both in diagnosis and treatment. We have only scratched the surface in educational electronics. The role electronics will play in speeding up the educational process, and in enriching it, staggers the imagination.

We need a completely new production technology, one that will enable us to compete against low-cost foreign labor. Surely a part of the answer to this problem will lie in staying ahead technically. It is possible that the breakthrough in this area will grow out of the new and exciting art of molecular engineering.

This is not so far fetched as it might sound. Only a few years ago radios were shoe-box size. Today, without compromising quality or performance, we are making them commercially the size of a package of cigarettes. It now appears possible to develop a thimble-sized radio so small it would not accommodate a speaker as we know them today.

We have come a long way in a short time and it is only the beginning. Our history, though short, already points irrevocably to a great and fruitful destiny. Let's live up to it. Our opportunity is great, so great as to be rare in history; it may never be as great again as it is today.

— GOVERNMENT —

THE SECOND AND THIRD POLARIS submarines were launched within the past two weeks. The Theodore Roosevelt was tested Oct. 3 at the Mare Island Naval Shipyard, Vallejo, Calif., and the Patrick Henry slid into the Atlantic Sept. 22 at General Dynamics Corporation's Electric Boat Division, Groton, Conn. The lead ship of the class designed as underwater missile stations is the George Washington, which was launched in June and is now being fitted for sea trials.

NSF 1960 ANTARCTIC RESEARCH PROGRAM begins this month when several scientists will climb the Skelton Glacier from McMurdo Sound for a three-month survey of Victoria Land, a desolate, ice-capped expanse of 7,000 to 9,000 feet elevation. Seismic soundings, gravity, magnetic and glaciological studies will be made. The National Science Foundation (NSF) program is supported by $3,170,069 in grants, which will provide both for field work in the Antarctic and for associated research in the U.S.

COMMISSION TO STUDY NEED FOR DEPARTMENT OF SCIENCE AND TECHNOLOGY was approved by the Senate Committee on Government Operations in order that Congress may have access to officials responsive to its requirements. The eight-man Commission would also provide Congress with the information necessary to solve problems relating to federal science programs. Under the present policy, Congress is denied access to such information through the appointment of officials who are responsible only to the President.

BILL GIVING FCC authority to regulate charges and services of microwave and other point-to-point radio circuits was passed by the Senate recently. The measure, introduced by Sen. Warren G. Magnuson (D., Wash.), is meant to clarify the Federal Communications Commission's present power to regulate charges in connection with the use of wires in chain broadcasting.

FIRST POLARIS FIRING FROM SHIP AT SEA took place recently when compressed air popped a 28-foot Polaris out of a tube buried vertically in the deck of the USS Observation, a 563-foot converted transport ship. The missile hit its target some 700 miles from the firing site off Cape Canaveral. Previously, attempts to fire the Navy vehicle were made on a land-based device, a ship's motion simulator.

AIR FORCE ATLAS NOSE CONE recovered from the South Atlantic after it was launched in July was the biggest re-entry vehicle yet flown in the free world. The General Electric-built vehicle is the first full-scale advance-design nose cone to travel intercontinental range and it is the first ICBM-range re-entry vehicle of this size designed to be recovered, according to General Electric Co. The recovery system for the vehicle was developed in cooperation with Cook Electric Co.

NBS HAS SET UP SPACE PHYSICS SEMINARS at Boulder Labs, Boulder, Colo. Called an interdivisional program on Measurement and Standards in Plasma and Astrophysics, the yearly or semi-annually National Bureau of Standards' seminars will bring together those participating in the program and serve as a review board for cross-division scientific planning.

NASA ESTABLISHES BIOSCIENCE ADVISORY COMMITTEE to study current U. S. capability in space-orientated life science and research development and outline the scope of problem areas in the space bioscience field. Headed by Seymour S. Kety, Chief of the Laboratory of Clinical Science, National Institute of Mental Health, the National Aeronautics and Space Administration group then will recommend the part NASA should play in future bioscience activity related to the national space program.

U. S. DEPARTMENT OF COMMERCE EXCEPTIONAL SERVICE AWARD for a major contribution to science and technology has been granted the Infrasonics Group of the National Bureau of Standards. The group was cited for "development of a superior system of instrumentation, of great immediate value to the success of world-wide national defense operations and of inestimable potential scientific usefulness."

CONTRACTS: ARMY: Radio Corporation of America, expansion of space-age electronics miniaturization program, $2,388,938; Aerojet-General Corp., surveillance drone systems, $4,900,000. NAVY: Carrier Corp., production of 15 air compressors to be installed in the USS Enterprise, $8,000,000; Texas Instruments Incorporated, advanced airborne surface search radar systems to be installed in aircraft for long-range detection of surfaced submarines, $9,373,728. AIR FORCE: Page Communications Engineers, Inc., design and construction of multichannel, tropospheric-scatter, telephone, teletype and data communications network linking United Kingdom, Spain and Morocco, $10,000,000; General Electric Co., Heavy Military Electronics Dept., production of radar course directing groups to automatically detect and track air targets, $22,000,000.

— INDUSTRY —

BELL AIRCRAFT CORP. has been selected to provide reaction controls for Project Centaur, the space vehicle which will be able to place a four-ton payload in orbit 300 miles from the earth or make exploratory, unmanned flights to the Moon, Venus or Mars. The Bell controls consist of small hydrogen peroxide thrust chambers installed at several locations on the space vehicle and are used to alter position within the flight path.

HEWLETT-PACKARD CO. has acquired all outstanding stock of Boonton Radio Corp., Boonton, N. J., Arrangements call for the transfer of Hewlett-Packard stock for all outstanding shares of Boonton stock, with Boonton becoming a wholly owned subsidiary. Earlier in the year, Hewlett-Packard acquired Palo Alto Engineering Co.

DIAMOND POWER SPECIALTY CORP. has announced what is believed to be the first broad based program for leasing of custom engineered closed circuit television systems anywhere in the United States and Canada. Management of lease contract arrangements are being handled in cooperation with American Industrial Leasing Co.

ELECTRONICS CAPITAL CORP. is one of the first investment companies to be organized under the new Small Business Investment Act for the purpose of devoting its resources to the broad needs of the electronics industry. Through its Group Development Concept, the San Diego firm promotes the development of companies who are able, in terms of management, products and services, to associate in special groups for the purpose of bidding on industrial and military procurement requirements.

RAYTHEON CO. has expanded its Government Equipment Division into five subdivisions in order to permit the division to handle its increasing government business more efficiently. The five units are: Airborne Electronic Equipment at Sudbury, Mass.; Heavy Electronic Equipment at Wayland, Mass.; Santa Barbara Subdivision at Santa Barbara, Calif.; Submarine Signal at Portsmouth, R.I. and Systems Management at West Newton, Mass.

ADMIRAL CORP. has announced the availability of a 7-transistor pocket radio, the Comet, carrying a national list price of $29.95. The Comet weighs less than one pound in a non-breakable case, has seven matched transistors and two germanium crystal diodes and contains a built-in ferroscope antenna.

REPUBLIC AVIATION CORP. has expanded work on interplanetary plasma engines by doubling the size of its Plasma Engine Lab and beginning the construction of a second experimental magnetic pinch plasma engine. Applied research and advanced development on a plasma engine, which may power a spaceship, is being carried on under contracts from the Navy's Office of Naval Research and the Air Force's Office of Scientific Research.

U. S. TRANSISTOR CORP. is a new electronics company with manufacturing facilities at Syosset, L.I. The firm, which acquired the complete sales organization of Super Electronics Corp., will produce a complete line of germanium alloy junction and silicon transistors for use in computers, communications devices and military components. U. S. Transistor will have its own R&D department.

NORTHEASTERN ENGINEERING, INC. has been awarded several contracts from the Army and Navy totaling approximately one half million dollars for work on high speed frequency converters, radio test sets and test oscillators. Located in Manchester, N. H., the firm specializes in precision electronic test equipment.

HUGHES AIRCRAFT CO. has established a nuclear electronics lab to handle the company's increasing activities in the nuclear field. The new lab will expand company activities in radiation effects research, design and construction of complete radiation lab facilities and manufacture of "Mobot" remote control handling devices. The Mobot is a device with flexible steel hands and television-camera eyes that can handle dangerous radioactive materials in "hot" labs. *(Continued on page 44)*

MOTOROLA MILITARY ELECTRONICS CAPABILITIES REPORT:

Strategic Deployment of Technical Personnel

Dr. Daniel E. Noble, Executive Vice President, Motorola, Inc.

"Dynamic organization...not static...is the key to productive use of technical talent in the field of military electronics."

The next two pages tell how Motorola has achieved "dynamic organization"...

William S. Wheeler, Vice President and General Manager
Military Electronics Division

Arthur Reese, Vice President and General Manager
Communications Division

Three field commanders direct day-to-day activities of Motorola's technical divisions. Wheeler's Military Electronics Division concentrates directly on military problems, drawing on the resources of Reese's Communications Division (world's largest producer of two-way communication systems) and Hogan's Semiconductor Division (world's largest producer of power transistors and leader in mesa transistor development and production). Behind this technical task force stands Motorola's strength in consumer electronics; in an emergency the company's total complex of 18 plants in four states can be converted to mass production of military equipment.

Dr. Lester Hogan, Manager
Semiconductor Products Division

Of Motorola's 2,000 engineers and scientists, four out of five work under the direction of Dr. Daniel E. Noble, Executive Vice President. One of the three divisions under his command is devoted exclusively to military electronics; two others provide strong support. Working together, they form a

MOBILE TECHNICAL TASK FORCE

Officials of the Air Force Flight Test Center at Edwards faced a particularly knotty problem. Specialized microwave equipment was required to relay telemetry from aircraft in remote areas.

At the request of the military, Motorola rapidly assembled the talent and equipment of its tri-divisional technical task force. Heaviest contributions to the project were made by Motorola's Military Electronics Division. But important help came from other sources: microwave equipment and vhf receivers from Motorola's Communications Division; specialized transistor circuitry from the Semiconductor Products Division.

With this swift concentration of technical talent drawn from a diversity of company sources, Motorola was able to solve a major problem for the Air Force in record time.

Few organizations serving the military today can so rapidly merge diverse technical talents and productive capacities as can Motorola. Its three "task force" divisions, under the single command of Dr. Daniel Noble, can be marshalled almost overnight for the solution of urgent military electronics problems. Cross-fertilization of ideas and techniques is the certain result.

The success of this flexible organizational structure was again demonstrated by Motorola's part in the development of the Project Mercury Space Capsule. The Capsule's command control receiver, developed by Motorola's Military Electronics Division, is the smallest all-transistorized radio receiver of its type available, thanks to mesa transistors developed by the Semiconductor Division and miniaturization techniques borrowed from packaging specialists of the Communications Division. In another instance, Motorola's Semiconductor Division developed the first samples of a new type of electronic facsimile paper with important military applications.

In an era marked by a chronic shortage of competent brain-power, Motorola's strategic deployment of its technical resources is an effective answer, both in the solution of current problems and in conducting long-range research.

Strategic deployment of manpower is only one of the reasons why Motorola is able to design, develop and produce military systems and equipment with speed, economy and reliability. Motorola's exclusive concentration in electronics, its cost-conscious approach to producibility, and its preoccupation with reliability, are evident in every Motorola military product, from the smallest solid state device to the most complex weapons systems.

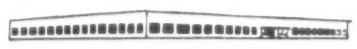
For a comprehensive brochure on Motorola's Military Electronics capabilities, write: *Technical Data Service, Motorola, Inc., Military Electronics Division, 8201 East McDowell Road, Scottsdale, Arizona.*

MOTOROLA

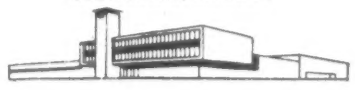
Military Electronics Division CHICAGO · PHOENIX · RIVERSIDE

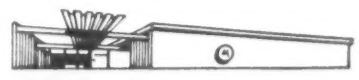
Engineers and Physicists interested in career opportunities are invited to write: Motorola, Inc., Military Electronics Division

1450 NORTH CICERO AVENUE
CHICAGO 51, ILLINOIS

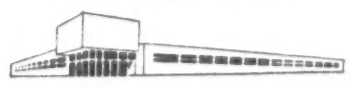


8201 EAST McDOWELL ROAD
SCOTTSDALE, ARIZONA





8330 INDIANA AVENUE
RIVERSIDE, CALIFORNIA



A-98-7

Tunnel Diodes

(*Continued from page* 14)

Mr. Fancher

ASSESSING A NEW electronic component and especially one as new as the tunnel diode is never an easy job. You always run the risk that later your profound words of wisdom may come back to haunt you.

However, in this case I think we are on pretty safe ground—the tunnel diode is a remarkable device. Its impact will depend on the ingenuity of the circuit designers to utilize its unique characteristics.

The scientific work performed in the Research Laboratory and the Advanced Semiconductor Laboratory has rapidly transformed an interesting scientific phenomenon into a distinct commercial probability.

A new active electronic component is more than just another piece of hardware. It gives the designer the freedom to improve existing equipment, devise new equipments and thereby generate a lot of new businesses. This, as you know, is the history of the effects of the invention and practical reduction to practice of transistors.

The basic building blocks of electronic equipment, such as transistors and tubes determine not only whether the equipment is large or small but even as importantly what it will do and how reliably it will operate. To improve equipment you can shuffle the components that make it up but you are limited by the building blocks you have available as to possible improvements. The limitations of the components are transferred directly as limitations of the equipment itself. Add a new building block like the tunnel diode and you open the door not only to significant improvements in size and capability, you also can devise wholly new equipments.

This it seems to me is the significance of the tunnel diode and the work our scientists have performed in gaining the basic understanding of its operation and in now transforming it into a practical and useful device.

Let us take a look at the tunnel diode from an equipment viewpoint. First of all we do not see it primarily displacing transistors or other active components in circuits. True in some instances it may do this, but broadly tunnel diodes should improve the functional worth of other active components by working with them. In addition we believe tunnel diodes together with other semiconductor devices will make possible the practical design of equipment now either impossible or impractical. As an example, cryotrons* are very fast computer elements, but they only perform at temperatures close to absolute zero.

**Editor's note: a device which utilized for switching purposes the fact that super-conductive transition depends upon temperature as well as electro-magnetic field. The great advantages of these devices are the extremely small size in which they can be utilized and their low electrical requirements, both of which are important in modern equipment using a great number of switches.*

They need a small amplifying component to work with them. For practical use this amplifier must work along side the cryotron and in the same very low temperature environment. The tunnel diode appears to fulfill this need.

Secondly, to the equipment designer, tunnel diodes have a lot to offer. In addition to working well at the temperature of liquid helium (only a few degrees above absolute zero), they also perform virtually unchanged at the freezing point of water, at room temperature and at 600 degrees Fahrenheit. As far as I know, this temperature range is unprecedented in electronic devices. They have other important attributes too. They are unaffected by extremely high levels of fast neutron irradiation. Gamma rays don't bother them either. They also switch currents very fast. In addition they work at very low voltages, yet have been made to handle as high as five amperes of current. They also are extremely fast pulse generators. All of these features are desirable in separate devices. In one device they are phenomenal.

However, with all this there still could be more. We are not sure yet of the full implications of the applications work we have carried on so far. Results to date are promising and certainly assure us of many areas where tunnel diodes will be practical.

Like transistors, the many uses for tunnel diodes cannot be satisfied by a single unit. Already we can see a variety of separate types of tunnel diodes for such applications as oscillators, mixers, amplifiers, switches, drivers, and detectors. We envision a whole family of tunnel diodes just like our present-day families of transistors and rectifiers.

But probably the two largest applications will be in the communications field (everything from broadcast receivers to two-way radios to high-frequency satellite transmitter), and in the computer field for logic circuits.

In high frequency communications equipment, one tunnel diode can perform several functions. In places like earth satellites and guided missiles where space is very dear, such a miniature active component is very desirable because it increases the work output load ratio so that more vital information can be transmitted.

In computers, together with transistors, tunnel diodes offer the opportunity for much higher speed operation; and today speed is a bottleneck in complex data handling requirements.

From an electronic component manufacturer's viewpoint, the tunnel diode is appealing primarily because it looks as if it offers us the opportunity of giving the equipment designer what he is always seeking—a small, highly reliable and versatile active element for his circuits at a reasonable price. Compared to transistors and rectifiers it appears that tunnel diodes will be relatively simple to manufacture since, for one thing, they are not as sensitive to surface variations.

As equipment requirements have demanded higher frequency performance from transistors, the device structures are becoming more and more complex and difficult to manufacture. The tunnel diode offers the opportunity of extending the frequency range of solid-state components without a corresponding increase in the complexity of the structure.

Tunnel diodes are now beginning to move out of the research area and into an advanced development phase.

We at General Electric will be offering limited experimental samples for use outside the Company for circuit and other applications development work. They will be available sometime in October. This will permit the circuit development work so necessary to the practical reduction to equipment design to proceed rapidly. Since these samples will be handmade in advanced development, the initial price will be fairly high in relation to their selling-price when we are in production.

However, the research job is far from complete and major efforts in this area must and will continue.

In the future wholly new solid-state devices and improved present ones may result from the better understanding of the quantum mechanical tunnelling effect described by Dr. Hebb. We in the product end of the business are looking forward to his and his associates' continuing achievements in giving us the fundamental knowledge we need for expanding and improving the uses of electronics.

the mobile digital defense environment

a discussion by industry and military of electronic air defense system AN/MSQ-18

by

Dr. Nicholas A. Begovich
Director of Engineering
Hughes Aircraft Company
Fullerton, California

Brigadier General Earle F. Cook
Deputy Chief Signal Officer
United States Army

(Above) Left Panel: In the "Operations Central" unit, detection, target assignment and target status data is transmitted to four or more antiaircraft missile batteries in the network. Adjacent truck-mounted coder - decoder groups convert target position data to usable form for missile firing. Center Panel: An Army commander assigns approaching hostile aircraft to a particular battery, permitting Army units to concentrate accurate fire depicted in the right panel. (Right) Dr. Nicholas A. Begovich looks on as radar operator, Specialist Fifth Class James Herrick, mans controls in system's "Operations Central."

Dr. Begovich:

WITH THE ARMY'S new AN/MSQ-18 electronic air defense system, we are observing the emergence of a striking new concept in the technology of defense: the *mobile digital environment*. Since this development is literally an evolutionary step forward in defense electronics, I would like to present some of the basic thinking which led to its creation. Thereafter, I shall explain how these fundamental ideas resulted in the many novel, interesting and deeply important technical advancements of which the AN/MSQ-18 is compounded. The use of the AN/MSQ-18 in semiautomatic coordination of the Army's modern Nike and Hawk missiles will, I am sure, take on a deeper significance in the perspective of this discussion.

One of the primary considerations in the development of an air defense environment is the distribution of information. For example, when as few as two field weapons, such as surface-to-air missile batteries, are participating in the defense of an area, a communication problem is entailed. For optimum defense against a group of enemy aircraft, each battery commander should know precisely how the other battery is engaged, and should have an up-to-date picture of the progress of the engagement. When information is available on whether aircraft over the area are friendly or hostile, this data should be accessible to both batteries. Each battery should also inform the other of new aircraft tracked, and of raid sizes. Only through the rapid interchange of such information can the battery commanders satisfactorily assign their weapons.

As the number of field batteries involved is increased to three, or four, the coordination problem increases in complexity. Equipment used for the display and transmission of information must be shared by data arriving from different batteries, thus the time consumed in each facet of coordination becomes a critical consideration. Further, more than one mode of communication may be needed for the most effective defense pattern. At times it may be desirable to employ the decentralized communication mode, in which each battery commander, with a maximum of information on the activities of the other batteries, makes his own target assignments. At other times, the exigencies of the air battle may make it desirable for all batteries to communicate with, and through, a central

post. This would permit centralized monitoring of activities, centralized assignment of batteries to specific defense tasks, and simplified netting of the weapons complex with similar systems defending adjacent areas.

In addition to a flexible communication scheme, the air defense environment must include facilities for acquiring information such as the position and identity of air targets. For this purpose, inputs to the system must be provided for search and identification radars, and for tactical data originating from remote sources. And since the data obtained from various sources may not be directly usable by the batteries, the system must include the capability to process or convert the information as necessary. Further, to permit tactical monitoring or centralized control of the weapons being coordinated, information display and command facilities must be available at a central post. Most importantly, of course, an environment possessing all of these capabilities must be adaptable to fast changing tactical situations. For example, it must be possible to increase or decrease the number of weapons coordinated, and to accommodate changes in battery emplacements quickly. In fact, as the defense of new areas becomes critical, the entire system must be readily transportable over any terrain to a new location.

The inevitable conclusion from these considerations was that the only approach offering sufficient capability, speed, compactness, and flexibility for modern air defense was the mobile digital environment. As a consequence this became the guiding concept in the development of the AN/MSQ-18. In this system one to eight Hawk or Nike missile batteries are coordinated through a mobile Operations Central. Both the centralized and decentralized communication modes are continuously available within the system and facilities are incorporated for acquiring target position and identity information, and for processing raw data for use by the batteries. Typically, radar data acquired at the Operations Central appears on the electronic indicator consoles for monitoring or command of the tactical situation. This information is then converted into digital form and transmitted to the Coder-Decoder vehicle located at each battery in the system. Here the digital messages are automatically translated for use by the battery. In return, action being taken by any battery is transmitted in digital form from its Coder-Decoder vehicle to the Operations Central vehicle, and from there to all other batteries. These high-speed transmissions contain such essential information as battery engagement status, the position coordinates of targets being tracked at the batteries, and raid sizes. Thus, the mobile digital environment virtually achieves a metamorphosis, through which a group of individual weapons is converted into a fast-reaction defense organism of formidable power against an enemy.

Before proceeding to discuss how the mobile digital approach to air defense coordination has brought about the many significant engineering advances which the AN/MSQ-18 embodies, I would like to offer some thoughts about the concept of a "vest pocket" defense system. The fact that the AN/MSQ-18 is a small electronic digital defense system does not imply that larger digital systems are impractical or beyond the present state of the electronic art. Quite the contrary. The Army's Missile Monitor, in evaluation testing, is a large-scale, high-capacity, mobile digital air defense system. In fact, it can be revealed that the AN/MSQ-18 is actually a building block within the Missile Monitor system. The point I am making is that certain rather explicit defense requirements must be met with a small, rather than with a large system. By tailoring a system to the local defense requirement, the all-important characteristics of system simplicity and economy are achieved.

Electronic Technique

To return to the digital approach in weapons coordination equipment, it may be helpful if this electronic technique is explained briefly. The two major methods for handling and processing data in electronic systems are the digital and the analog methods. Now each of these has an established place in electronics as a whole, but current developments have proved the superiority of digital methods for high-speed processing and transmission of information. Let me clarify the distinction in this way: With analog methods, the variation of some physical quantity, such as the position change of an air or space vehicle, is converted into voltages or currents which at every instant represent the physical variation. Unfortunately, analog data handling equipment tends to be bulky and electrically unstable, and analog data is inherently unsuitable for long-distance transmission. With digital methods, variations in the physical quantity are converted into a code consisting of a series of voltage states, or digits. When the quantity varies, the digital code which represents it changes. Conversion of the physical quantity into a representative group of digits permits computations to be performed with ease by compact equipment which does not require critical adjustment. Transmission of data may be accomplished at high speeds and over great distances, with an arbitrarily high transmission accuracy.

By combining digital techniques with mobile equipment design, a number of important advances have been incorporated in the AN/MSQ-18. One of these advances is *modular design*, which has been used on several levels in this equipment. First, the entire system represents a building block, in that with appropriate techniques AN/MSQ-18 systems may be linked together to provide a large-area air defense system of extended capability. Also, the automatic Coder-Decoder battery terminal equipment is a digital module. Further, modular construction has been employed within the electronics equipment installed in the AN/MSQ-18 trucks. For example, a basic equipment drawer construction is adapted to different electronic functions. Beyond this, smaller units of the electronic circuitry are mounted on light-weight cards which plug into the drawer structures. Again, these standard digital circuit cards are employed over and over in the same basic forms.

Another feature of the system, which goes hand in hand with modular design, and which was made possible by the digital approach, is the extensive use of *transistors and semiconductor diodes*. These are small, solid-state devices which are widely used in digital circuits in place of conventional electron vacuum tubes. These components are not only much smaller than tubes, but are physically more rugged and require less electrical power for their operation. As a consequence, a dozen or more semiconductor components, together with 70 or 80 other circuit elements such as resistors and capacitors, may be mounted on a single printed circuit card about 5 x 8 inches in size. These digital circuit cards, which are designed to plug into the digital equipment drawers, may be mounted quite close together, since they produce only a fraction of the heat developed by vacuum tubes. Naturally, such small, compact construction is ideally suited to a mobile equipment design.

In summary, I think it is interesting to note the train of favorable consequences which have followed from the design philosophy of the AN/MSQ-18. Primarily, a vital defense system has been shaped into a rugged, transportable military equipment, ready for use with the Army's surface-to-air missiles in any location. When in operation, the system is highly accurate, reliable, and trouble free. In all, it is apparent that the AN/MSQ-18 "vest pocket" system represents a solid step in the advance of a new era of air defense.

General Cook

As Deputy Chief Signal Officer, I am happy to announce a new electronic communication and control system for the air defense system missile battalions of the field army. For the first time, our battalion commanders in the field have equipment for coordinating the firepower of their widely dispersed missile batteries in a matter of split seconds rather than many minutes, and they have it in time to fill a vital gap in air defense of the field army.

This equipment is now operational on a 24-hour basis with U.S. Army air defense units in Europe.

This system was developed for the Army Signal Corps by Hughes Aircraft Company and was delivered in late 1957 to the Army Air Defense testing facilities at Fort Bliss, Texas, where it underwent an intensified 4-month test.

It was subjected to the heat of the desert, the cold of the mountains, dust and sand storms, rain and high humidity, along with the shock of vibration received by equipment mounted in a 2½ ton GI truck driven over an obstacle course designed for testing the ruggedness of the truck itself.

Throughout these tests, the equipment proved itself to be one of the most reliable pieces of electronic hardware ever developed. It was officially accepted as standard Army equipment in March 1958 and has been deployed overseas.

Four-Fold System

The capabilities of this system are four-fold:

1. Speed—It provides the vitally needed speed for defense against hostile aerial targets by allowing pin point radar target data and commands to be sent to the widely dispersed Nike and Hawk batteries in a matter of seconds. This assures efficient assignment of missile battery units for prompt destruction of hostile aircraft at long range.

2. Mobility—It provides the highest degree of mobility required by a modern field army. By using the latest miniaturization techniques, we have been able to reduce the size of the equipment, which would ordinarily require installation in a sizable building, to where it fits nicely into a standard 2½ ton army truck.

3. Reliability — We were pleased with the reliability demonstrated by this equipment during evaluation tests. The same degree of reliability is being reported from operational troops overseas.

4. Coordination — For the first time, the battalion commanders have a continuous up-to-the-second picture of the air defense situation within their zone of responsibility along with the action status of all elements within the missile defense system.

How It Operates

Let me give you a brief word picture of how this system operates.

Let us say as an example that each system consists of one truck-mounted equipment located at the battalion and one truck-mounted equipment located adjacent to each Nike or Hawk Missile battery. As deployed, the battalion commander is situated to the rear of the battalion with electronic communication spokes connecting him with his forward missile battery equipments.

The battalion commander has display console equipment which provides him with up-to-the-second data on the tactical situation within his area. This equipment presents to him radar target data from his own battalion radar, from the missile battery radars and from other sources, such as the tactical area command, and also presents the action status of all the batteries.

When a hostile aircraft enters his defense area, he merely pushes buttons to transmit target data and commands to the nearest or most appropriate battery, for destruction of the enemy aircraft. In turn, all battery actions are relayed to him by push-button controls to enable him to determine at a glance the effective capabilities of his missile defense.

We have replaced tedious and time-consuming methods of hand-plotting radar target tracks and then transmitting target information and firing information to the batteries by voice telephone. We have replaced a method which required several minutes to transmit a message by one which requires only split seconds. Since attacking aircraft may well be flying at supersonic speed, you can readily see the importance of transmitting target position data and commands to the batteries instantly and accurately.

Even with a highly trained, efficient team, the element of human error enters heavily into the conventional target monitory process and has the effect of reducing the potential number of hostile aircraft kills. Our new system has taken an important stride toward correcting this situation. The system reduces to a minimum the element of human error by transmitting data at split-second speed, and is capable of handling hundreds of individual targets simultaneously.

Our new "vp" (vest pocket) air defense system for battalion level is designed for use with the Nike, Hawk and other missiles and is also designed to be part of the Missile Monitor Air Defense system for an entire field army area.

The Missile Monitor, also developed for the Army Signal Corps by Hughes Aircraft Company, is undergoing evaluation tests by the Air Defense Board at Fort Bliss, Texas.

One of the features of the Missile Monitor system is a new type of long-range radar called Frescanar which was announced last fall.

Frescanar utilizes a revolutionary principle of frequency scanning. This radar simultaneously provides range, azimuth and altitude of aircraft at long ranges and with greater accuracy than any conventional radar of the same power. The radar scans a pencil-shaped beam in elevation electronically to provide altitude, while the antenna from which the beam emanates rotates mechanically, giving range and azimuth. This method eliminates the need for a separate height-finding radar system and permits automatic tracking of hundreds of targets simultaneously.

We feel that in developing and producing this equipment, we have taken a very significant step in modernizing the field army's air defense capability.

We have provided combat army air defense commands with electronic equipment which is mobile, rugged, extremely reliable and which gives them the accurate and timely information required to coordinate air defense activities to meet the high-speed threat of today.

The AN/MSQ-18 was first shown to the press at a field demonstration at Fort Myer, Va., and for public viewing at the recent meeting of the Association of the U. S. Army in Washington, D. C.

vehicle-to-vehicle ground-wave propagation characteristics

by
W. S. BENNETT
and
L. R. ALLDREDGE

The Johns Hopkins University Operations Research Office

A HIGH PERCENTAGE of the tactical communications in the US Army has been carried over wire lines since the invention of the telegraph and the telephone. This means of communication has been very acceptable in the past which was characterized by relatively static types of operation. Communication over wires was relatively secure from enemy interception, and the lines could be laid rapidly enough to keep up with the existing slow rate of movement.

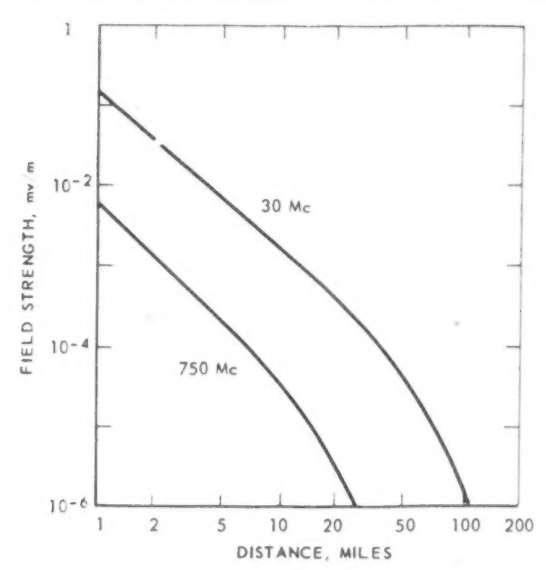
The advent of tactical nuclear weapons is one of the principal factors that has established the need for new tactics with increased troop dispersion and greater mobility in future warfare.

Future dispersed mobile-army operations will bring into focus new problems of intelligence collection and dissemination, command control, and logistics that cannot be met adequately with old established communication methods. Tactical communication links will be longer than in the past, and the requirement on speed of transmission of information and the frequent movement of command posts will preclude long delays in installation of communication facilities.

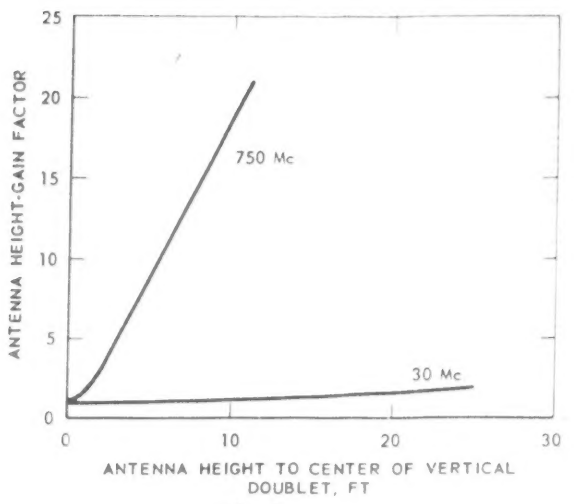
In a war of rapid movement most combat units at the lower echelons will be completely mechanized and there will be a great need for vehicle-to-vehicle communications in the vhf and uhf bands.

The primary means of tactical communications therefore must shift from wire to radio. Reliable radio links always must be available for use by troops on the move.

Implicit in the trend toward greater reliance on radio is the requirement for an understanding of the factors that affect the propagation of electromagnetic energy from the transmitter to the receiver. As contrasted to wire and cable circuits, the transmission loss of a radio path is subject to a much greater variability due to changes in range, antenna height, ground conductivity, tree cover, and topography. If reliable radio communications are to be realized, the extent of the transmission-loss variability must be predictable within defined confidence limits.



a. Surface-wave Field Intensity
(25 watts radiated from vertical doublet near ground having dielectric constant of 5 relative to air and conductivity of 10^{-14} emu)



b. Antenna Height-Gain Factors
(ground constants same as in Part a)

Fig. 1—Ground-wave Propagation Characteristics

Theory is Inadequate

It would of course be very convenient if theory could predict the details of ground-wave propagation. This is not possible. Any theory that attempts to utilize the details of the earth-air boundary conditions for any case except for idealized terrain will be unmanageable. In practice the boundary conditions are not even known. Nevertheless, simplified theories are useful in helping to understand average propagation characteristics and to help decide what parameters should be investigated in an experimental program.

Calculations have been made of the ground-wave field intensity over a finitely conducting spherical earth. The theory is complicated, but Norton[1] has summarized the results and has developed graphical methods that may be used easily by engineers. The ground wave does not include any portion of the wave reflected from anything other than the ground and is thus exclusive of ionospheric and tropospheric waves. The ground wave is usually the greatest contributor to the field strength out to distances of 30 or 40 miles.

This theory predicts that with very low antenna heights, the field intensity is independent of antenna height and is given by the surface-wave field intensity shown in Fig. 1a. For elevated antennas the field strength can be obtained by multiplying the surface-wave field strength by the antenna height-gain factor illustrated in Fig. 1b.

The much simpler plane-earth theory predicts that the field strength should vary inversely with the square of the distance and directly with the product of the antenna height and the frequency. This theory, because of its simplicity, is often used as a normalizing function in the presentation of experimental data, even though it disagrees with the more complicated (and presumably more accurate) spherical-earth theory.

Since no known theory can possibly account for the variations in signal strength which do exist under real field conditions, available field experimental

(*Continued on page* 32)

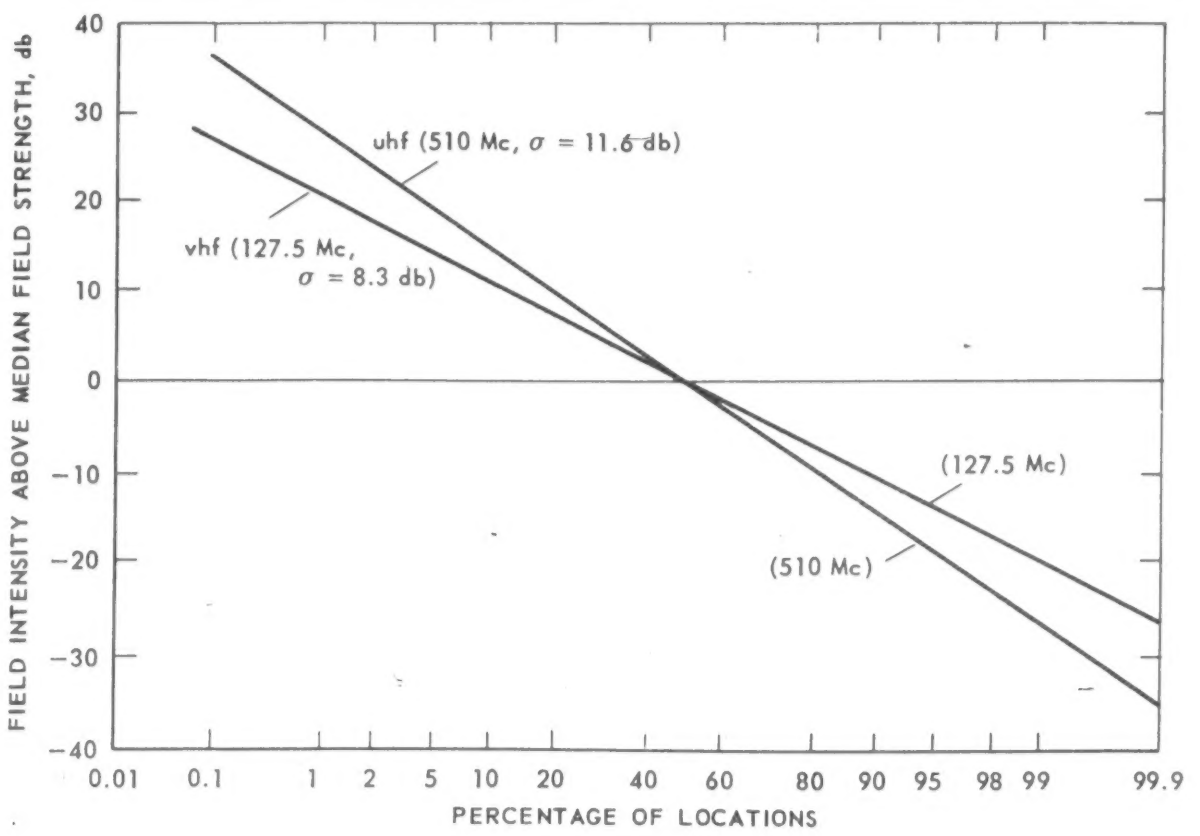
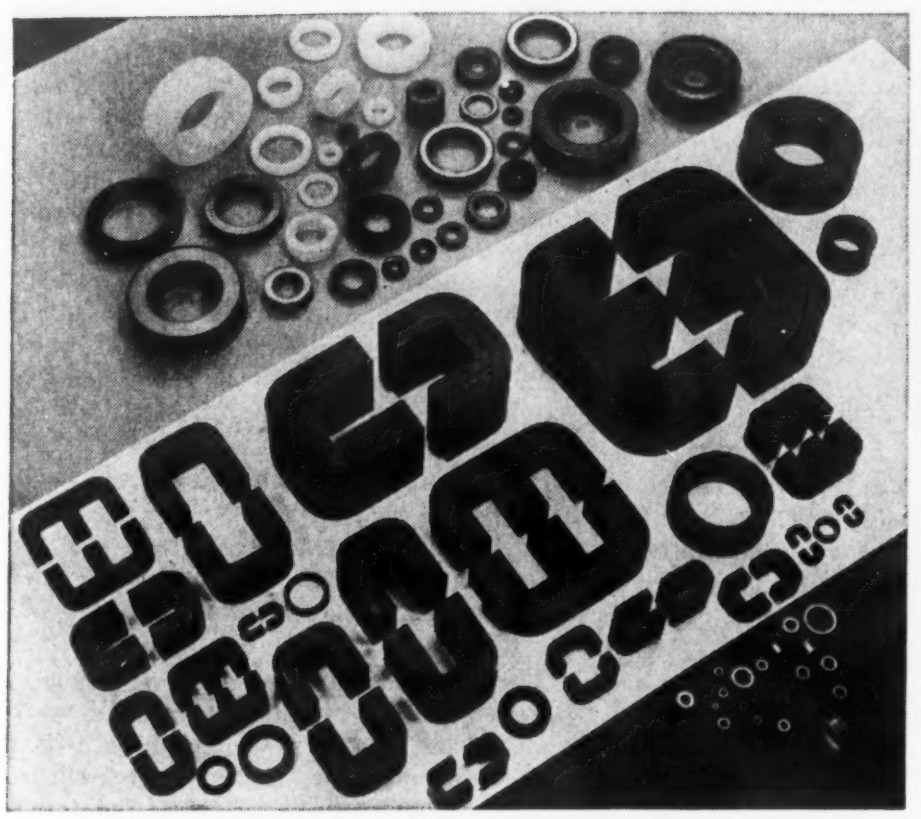


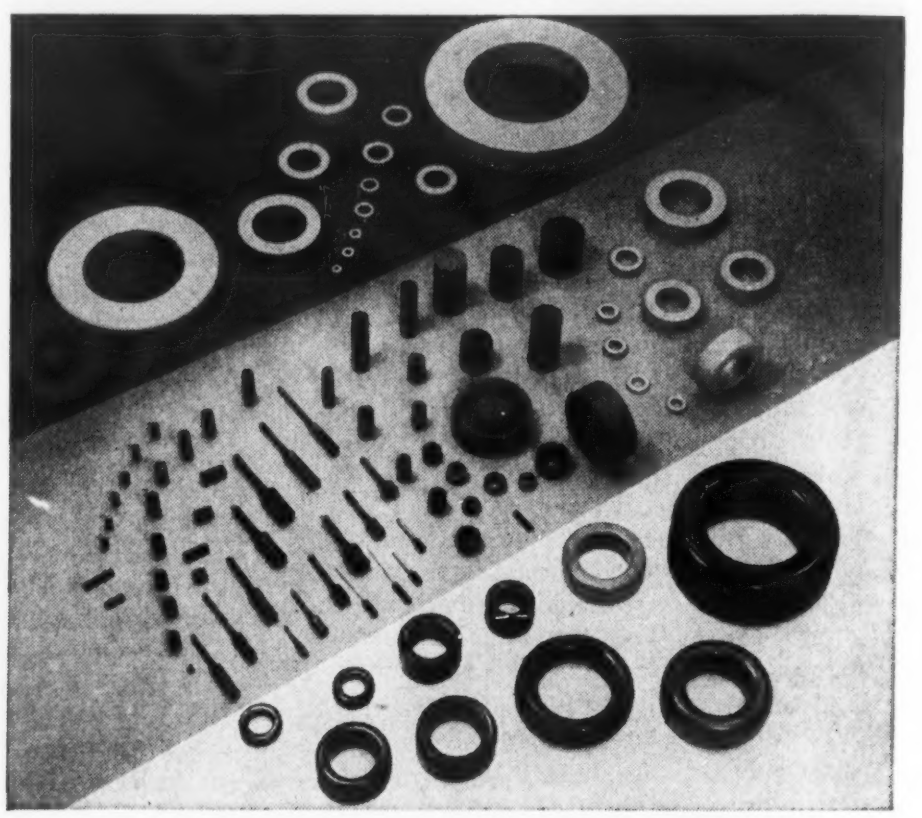
Fig. 2—Distributions of vhf and uhf Field Strength for Base-to-Vehicle Service

Specify "ARNOLD"

for your MAGNETIC CORE requirements



Top to bottom: Tape wound cores, Silectron C, E and O cores, and bobbin cores.



Top to bottom: Mo-Permalloy powder cores, iron powder cores, and Sendust cores.

SILECTRON C-CORES, E-CORES and TOROIDS Arnold C and E cores are made from precision-rolled Silectron strip in 1, 2, 4 and 12 mil thicknesses.

They are supplied in a wide variety of shapes, and in sizes from a fraction of an ounce to several hundred pounds. In addition to standard transformer applications, they may also be supplied for special applications such as saturable reactors, instrument transformers and pulse transformers.

Over 1,000 stock cores are listed in the Arnold Silectron catalog. A wide selection of preferred sizes are carried in stock for immediate shipment. For complete data on C and E cores and Silectron toroids, *write for Bulletin SC-107A*.

TAPE WOUND CORES of High Permeability Materials Arnold tape wound cores are available made of Deltamax, 4-79 Mo-Permalloy, Supermalloy, Mumetal, 4750 Electrical Metal, Silectron, or the new rectangular-loop material, Supermendur. All except Supermendur cores are available in standard tape thicknesses of 1, 2 and 4 mils; also in special tape thicknesses of ½ mil, 12 mil or other, as required or feasible. Supermendur is presently available in 4 mil cores.

Toroidal cores are made in 30 standard sizes with protective nylon or aluminum cases. Special sizes of toroidal cores are produced to individual requirements. *Write for Bulletin TC-101A*. (*TC-113A for Supermendur Cores.*)

BOBBIN CORES Arnold bobbin cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps to suit the ultimate use of the core in electronic computer assemblies. Magnetic materials usually employed are Deltamax and Square Permalloy in standard thicknesses of 1, ½, ¼ and ⅛ mil. Bobbins are supplied in ceramic or stainless steel. *Write for Bulletin TC-108A*.

MO-PERMALLOY POWDER CORES Available in a wide range of sizes, from .260" OD to 5.218" OD. They are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

These powder cores are supplied in four standard permeabilities: 125, 60, 26 and 14 Mu. They provide constant permeability over a wide range of flux density, and in many cases may be furnished stabilized to provide essentially constant permeability over a specific temperature range. Large warehouse stocks of preferred sizes are carried for immediate shipment. *Write for Bulletin PC-104C*.

IRON POWDER CORES A wide selection of cores is available, from simple cylinders to special cores of complicated design. The line includes all standard types of threaded cores, cup, sleeve, slug and cylindrical insert cores: for use in antenna and RF coils, oscillator coils, IF coils, perm tuning, FM coils, television coils, noise filter coils, induction heating and bombarder coils, and other low frequency applications. Preferred sizes are carried in warehouse stock for quick shipment. A standard series of iron powder toroids is also manufactured, conforming to the standard sizes proposed by the Metal Powder Industries. *Write for Bulletin PC-109*.

SENDUST POWDER CORES Available in a wide selection of sizes, ranging from .800" OD to 3.346" OD, and in permeabilities of 10, 13, 25, 30, 50 and 80, although not all sizes are available in all permeabilities. They possess magnetic properties generally superior to iron powder cores, but inferior to Mo-Permalloy powder cores in the audio and carrier frequency range. *Write for Bulletin SDC-110*.

SPECIAL MATERIALS

2V PERMENDUR . . . a ferromagnetic alloy of cobalt, vanadium and iron that possesses high flux density saturation properties. Its magnetostrictive properties are useful in many transducer applications. *Write for Bulletin EM-23*.

VIBRALLOY . . . a ferromagnetic alloy of nickel, molybdenum and iron whose temperature coefficient of elastic modulus is controllable over a wide range. It has high ferromagnetic permeability, and a rather high coefficient of magnetostriction. Used in applications where a zero or controlled thermo-elastic coefficient is desired.

BARIUM TITANATE . . . A piezoelectric ceramic widely used in accelerometers, phono pickups, microphones, ultrasonic grinding and cleaning devices and underwater signaling devices. For more information, *write for Bulletin CM-116*.

7807 B

ARNOLD

SPECIALISTS in MAGNETIC MATERIALS

THE ARNOLD ENGINEERING COMPANY, Main Office: MARENGO, ILL.
BRANCH OFFICES and REPRESENTATIVES in PRINCIPAL CITIES

Vehicle-to-Vehicle

(*Continued from page* 30)

data should first be examined. If adequate data are not available to describe the propagation characteristics, more field data should be obtained.

Experimental Data For Base-To-Vehicle Service

There is very little experimental data available on vehicle-to-vehicle propagation. Most experimental data on propagation in the vhf and uhf bands have been obtained from base-to-vehicle transmission where the fixed antenna was hundreds of feet above the surrounding terrain. Although the results may differ appreciably from vehicle-to-vehicle propagation, with low antennas at both ends of the link, they should be examined for trends.

John Egli[2] recently summarized a large volume of FCC data taken in or near a number of large cities in the United States. The experimental data indicated that for any given frequency the median field strength showed an inverse distance squared trend that corresponds to the plane-earth theory. The experimental data, however, indicated that the deviation from plane-earth theory varies inversely with frequency, being equal to the plane-earth theory at 40 mc.

It was found that the distribution of received field strength expressed in decibels (db) above the median value was normally distributed. Thus, on probability paper, the cumulative distribution is linear and may be described by its standard deviation, σ, as shown in Fig. 2. Egli suggested, for statistical reasons, that the variability of field strength for vehicle-to-vehicle service would have sigmas greater than those shown in Fig. 2 by a factor of the square root of two. Assumptions such as this should be checked experimentally before they are used. Further, more field data should be obtained in such a way as to permit an evaluation of the effects of terrain types and other operational parameters on the variability of the field strength.

Other Experimental Work

Egli's discussion of the FCC data was so tantalizing, in promising increased understanding of propagation variability, that an extensive search was made for other data. In 1942-1943 Jansky and Bailey studied propagation between vehicles at 4 mc, 28 mc, and (adventurously) at 116 mc.[3] Measurements were made in three areas—flat, rolling, and mountainous. In each area the transmitter vehicle was parked in a location chosen to have eight to ten roads radiating in as many directions away from the transmitter. Signal strengths were recorded as the receiver was driven away from the transmitter.

Comparison with Egli's results showed a similar frequency effect, but only the mountainous area gave as much attenuation or showed as great a variability (as large a σ) as Egli's. Indeed, a consideration of the sources of the FCC data indicates that the vast majority was taken in mountainous areas, principally in Pennsylvania. To apply such aggregate results in less rugged terrain would thus be unduly pessimistic in estimating the effectiveness of a radio link. Just as seriously, it would be unduly optimistic in considering invulnerability to enemy jamming or intercepting.

Intuition and reflection indicate that averages vary less than individual measurements: extremes are "averaged out." Mathematical statistics formalize this by proving that $\sigma_{\bar{x}} = \sigma_x n^{-\frac{1}{2}}$; that is, averages of sets of n values of a variable x show only $n^{-\frac{1}{2}}$ as much variability as individual values of x. Because most available data serenely report "average" signal strength, or "median" signal strength, without specifying n, there is no way to compare independent results accurately (even the previous comparison of FCC and Jansky-Bailey data suffers from this weakness).

The only other source of appropriate propagation data illustrated this difficulty with averages. A transmitter with a frequency near 150 mc was tested[4] at Fort Huachuca in varying terrain, but mostly flat or rolling or permitting line-of-sight communications. Every measurement was a single reading and $\sigma_x = 9.6$ db for all the data. In Flagstaff, Arizona, purposely chosen for rugged terrain and high timber to give a large σ, the test procedure yielded $\sigma_x = 7.7$ db. Unfortunately the n entering into $\bar{x}$ is not known.

These anomalies, and gross differences between different paths in the same terrain, indicate many unknowns still to be understood before ground-wave propagation can be described well enough to predict performance. Yet performance must be predicted (and is being predicted) to establish design criteria or to evaluate proposed or existing systems. Clearly such predictions are either conservative, leading to extravagant requirements, or optimistic, leading to poor dependability. Knowledge is needed of the effects of frequency and range most obviously, but also of terrain ruggedness, antenna height and its relation to vegetation height (thus season) and effects due to motion of transmitter or receiver. In fact, it is even desirable to distinguish the two possible directions of transmission between two ground points.

Statistically-Designed Experiments

Under the old dictum of "hold all variables constant but one and vary it," an experimental program to determine the effects of all the variables mentioned above becomes unmanageable. Fortunately there is a branch of applied statistics specifically concerned with the statistical design of experiments. It deliberately programs simultaneous changes in different variables in such a way that independent estimates are obtained *just as if each variable were treated separately*. The technique known as analysis of variance is employed and the appropriate experimental-design for the propagation test is known as a factorial design.

The design and analysis techniques for a field experiment are essentially inseparable so that even the best analysis usually cannot salvage a poorly-designed experiment. When a single value of σ is reported for a great variety of tests, as for the FCC data, it actually includes components due to all the variables *and* their interrelationships with one another. Properly designed experiments program the variables through a set of linearly independent combinations so that the total variance can be partitioned into the parts attributable to each separate variable *and* to the interrelationships. The residual variance is left as the measure of variation due to inconstancy of uncontrollable causes (temperature, humidity, soil conductivity, and dielectric constant, etc.).

Consider the impact of even a small reduction in our uncertainty. A 10-watt transmitter gives a 50 percent probability of reception at a given distance and we wish to know how much power is necessary to give 95 percent probability at the same distance. If $\sigma = 10$ db (a frequently-cited value), the answer is 500 watts. But a 20 percent drop, to $\sigma = 8$ db, calls for only 230 watts while a 20 percent increase ($\sigma =$ 12 db) calls for 1100 watts! Obviously db scales are deceptive. Obviously if we know we are talking about smooth terrain and 8 db is appropriate we want to be able to use 8 db and not be penalized for greater variability in other terrain.

It is clear that a better knowledge of the factors which contribute to the large variation in field strength for vehicle-to-vehicle ground-wave propagation would be an aid to the user and is essential to the design of the radio equipment. Sufficient data taken in the proper form are not available. Properly taken additional field data are required for an understanding of this important problem.

REFERENCES

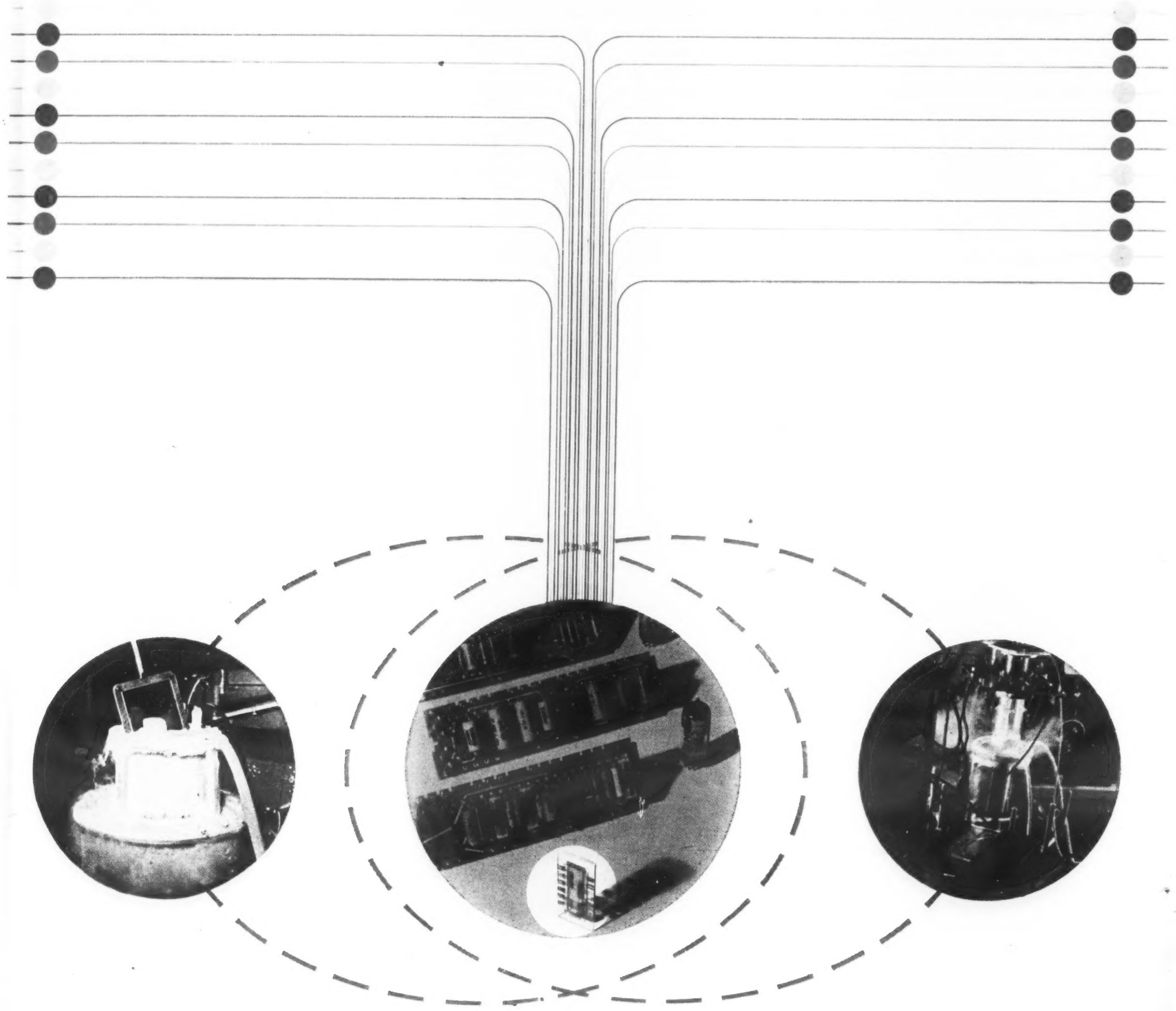
1. K. A. Norton, "The Calculation of Ground-Wave Field Intensity Over a Finitely Conducting Spherical Earth." *Proceedings of the IRE*, 29: 623-639, Dec. 1941.
2. John Egli, "Radio Propagation Above 40 mc Over Irregular Terrain," *Proceedings of the IRE*, 45: pp 1383-1391, Oct. 1957.
3. Jansky and Bailey, Inc., "Radio Telephone Communications Between Mobile Units," Final Report on NDRC Contract No. OEMsr-174, June 1943.
4. Motorola, Inc., Western Military Electronics Center, Phoenix, Arizona, "Field Tests of Communication Central AN/MRC-66 (U)," Final Report, Contract No. DA-36-039-72346 (Mod. No. 4), May 1958.

AT MINUS 453° F. MINIATURE COMPUTERS DO THE WORK OF GIANTS

Many computers of the future will operate on principles of superconductivity at the temperature of liquid helium. Components of extremely small size will combine with compact circuitry to realize greatly increased speeds of operation. Studies are in progress in the application of low-temperature or cryogenic phenomena to the development of advanced electronic systems for military use. For many years, the IBM Federal Systems Division has been engaged in cryogenics research, with special emphasis on systems technology. The aim is to evolve extremely compact computer units of improved reliability for the service of national defense requirements. Complete facilities for: **Research · Development · Manufacturing · Testing · Product Support · Systems Management.**

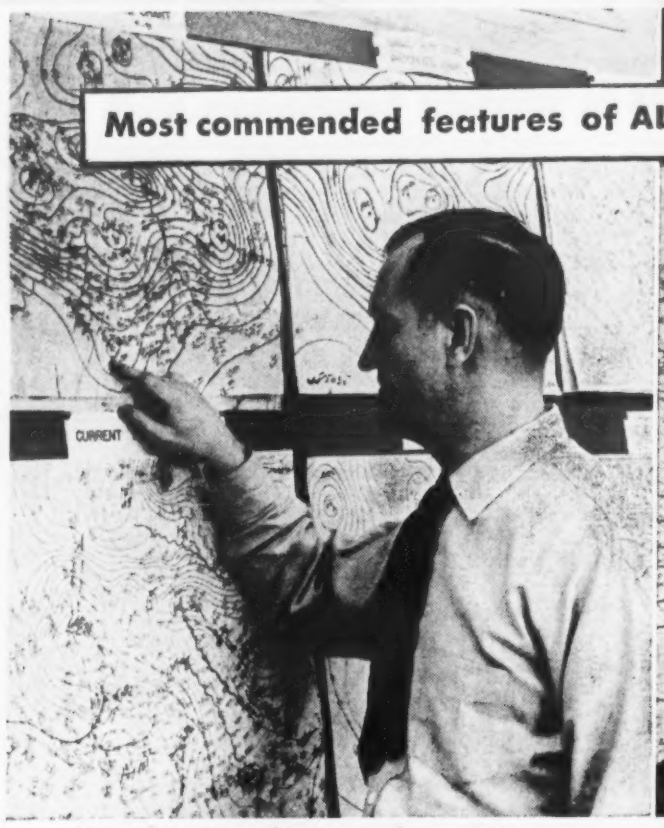
IBM®

FEDERAL SYSTEMS DIVISION
International Business Machines Corporation
590 Madison Avenue, New York 22, N.Y.



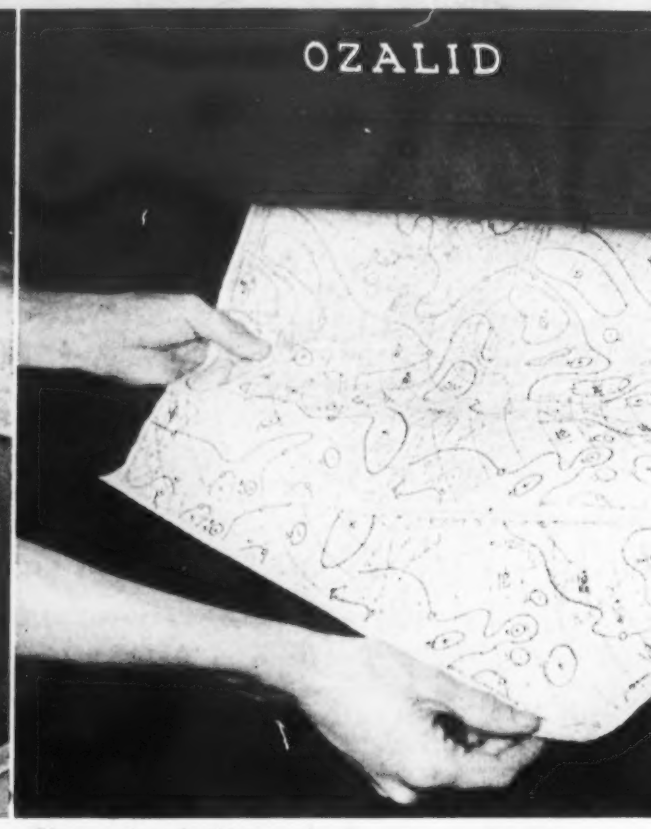
In center, conventional circuitry is contrasted with equivalent cryogenic device (in white circle). Left and right photos show details of specially designed apparatus used to achieve low temperatures for superconductivity.

Most commended features of ALFAX Maps



Crisp brown markings on clean white paper

Ease of writing and erasing enhances analysis



Clear crisp duplicates by Bruning or Ozalid

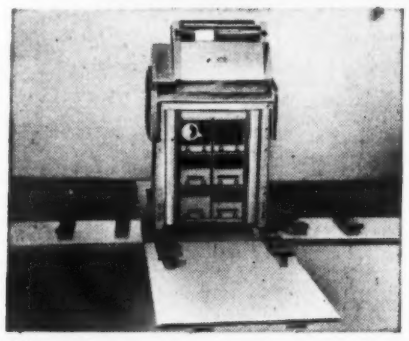
- PLUS THESE UNIQUE FEATURES . . .

LOW COST—Alfax paper cost savings on full schedule operation save 1/3 to 2/3 in yearly operation costs.
CLEAN—electricity is the ink for Alfax paper, ion deposits make crisp brown marks without dust, smudge or chemical irritants.
STABLE Alfax stores indefinitely . . . contains no voids or splices . . . recording marks are permanent.

Here's why . . . FORECASTERS PREFER . . . EQUIPMENT AND ALFA

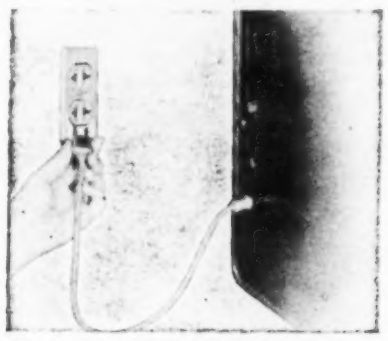
Most commended features of ALDEN RECORDERS

- ***EASE OF INSTALLATION*** . . . **compact and mobile**



Uncrate

Roll in

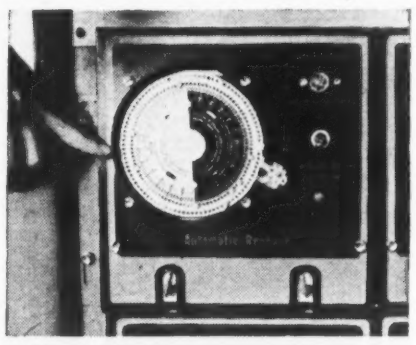


Plug in

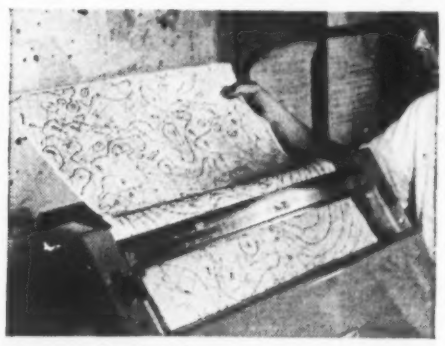
Clean crisp maps

- ***EASE OF OPERATION*** . . . **new high in clean, quiet operation**

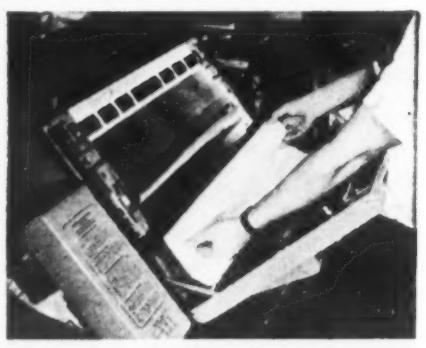
Automatic and continuous



Time clock programming

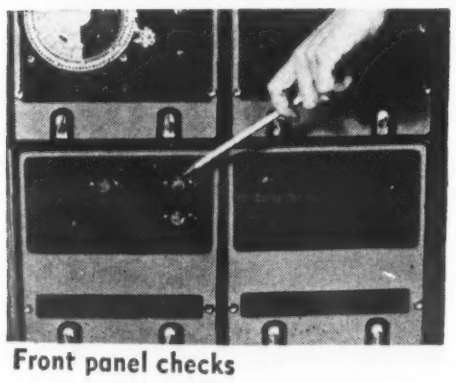


Instantly visible

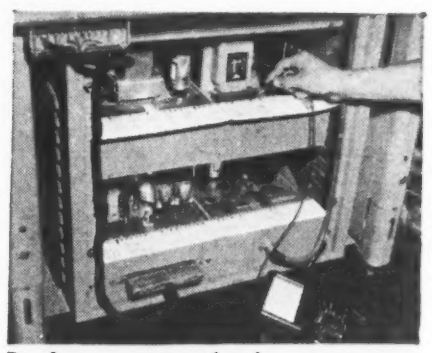


Easy paper loading

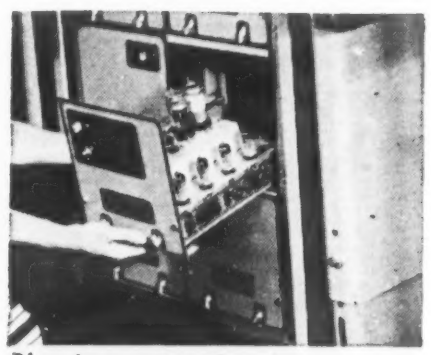
- ***EASE OF MAINTENANCE*** . . .



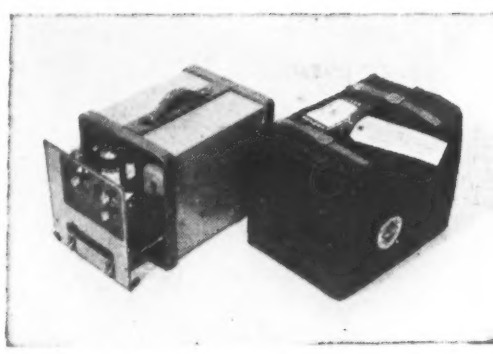
Front panel checks



Back connector checks



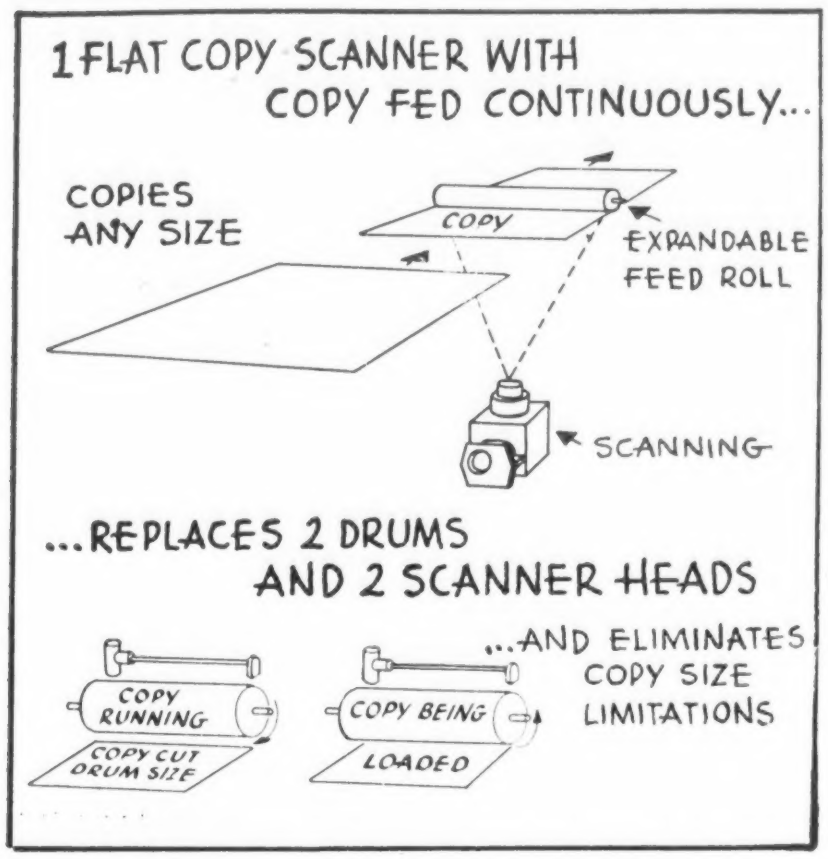
Plug-in construction



Air Freight replacement

- PLUS THESE UNIQUE FEATURES . . .

SECURITY—low voltage marking process does not generate a signal that can be intercepted.
HIGH SPEEDS—60-90 or 120 rpm operation . . . recorder technique and paper capable of fifteen times these existing speeds.
PRODUCTION—designed for volume production on short lead time . . . using unique expandable manufacturing techniques.



ALDEN FACSIMILE MAPS...

. . . and why we think you'll like them too.

Since 1954 Alden Facsimile Weather Map Recorders and Alfax maps have been replacing existing facsimile equipment on the National facsimile Weather Map Network at an accelerating rate.

U. S. Weather Bureau stations converting to Alden equipment will be complete by the end of the fiscal year with many independent forecasters, air lines and institutions following suit.

The new U. S. Weather Bureau's high altitude weather network, local and overseas networks are being expanded with Alden Facsimile Recorders and continuous flat copy scanners.

*Fifteen out of twenty forecasters after having operating experience with all weather facsimile systems indicated a *marked preference for* Alden Recorders and Alfax Maps.

ALDEN ELECTRONIC AND IMPULSE RECORDING EQUIPMENT CO., INC.
Westboro, Mass.

NEW BOON TO CONTINUOUS FACSIMILE NETWORK OPERATION REALIZED WITH ALDEN FLAT COPY SCANNING SYSTEM

Compact, mobile flat copy scanners provided by Alden Electronics Company, Westboro, Mass. moved onto the new U.S. Weather Bureau Hi-altitude Weather Facsimile Network Feb. 16, 1959 to begin a new era in simplified facsimile communications systems

- **INSTALLATION SIMPLIFIED . . .**

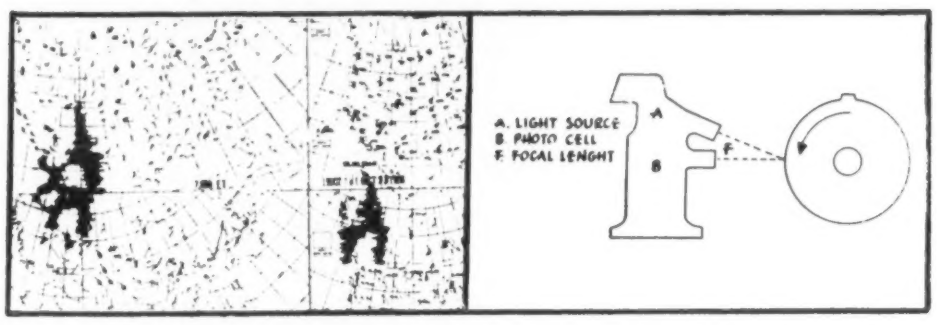
  Uncrated from fold-a-way shipping boxes at Suitland, Maryland, and Idlewild, N.Y. — Alden scanners rolled in, plugged in and turned on to begin new era in weather facsimilie networks. Tested in 2 hours for 60, 90, 120 rpm, the equipment was turned over to the U.S. Weather Bureau personnel the same day. Addition of transmission and receiving points has been expanded with *higher speed operation* of 120 rpm started June 20th on completion of line balancing by American Telephone and Telegraph Co. which doubled the speed, transmitting copy of the same detail (size of characters and information *not* enlarged) as at 60 rpm.

- **EASE OF COPY HANDLING . . .**

With map sizes no longer restricted to drum mounting, continuous transmissions of maps (one after the other) with one scanner halves the space and maintenance problems, makes possible *scanning the original* plotted maps without cutting to size; map plotters and forecasters have *originals back in ½ the time.*

Flat Copy Scanner with expandable copy feed head takes maps any width or length — fed straight or kitty corner.

- **FOCUS SMUDGE ELIMINATED**



Focus smudge caused by unusually thick copy or copy lifting from drum.

With copy feed rolls precisely positioning surface of map on flat copy scanner table, exact focal lengths are maintained for clear, sharp recordings.

- **MOST COMMENDED FEATURES**

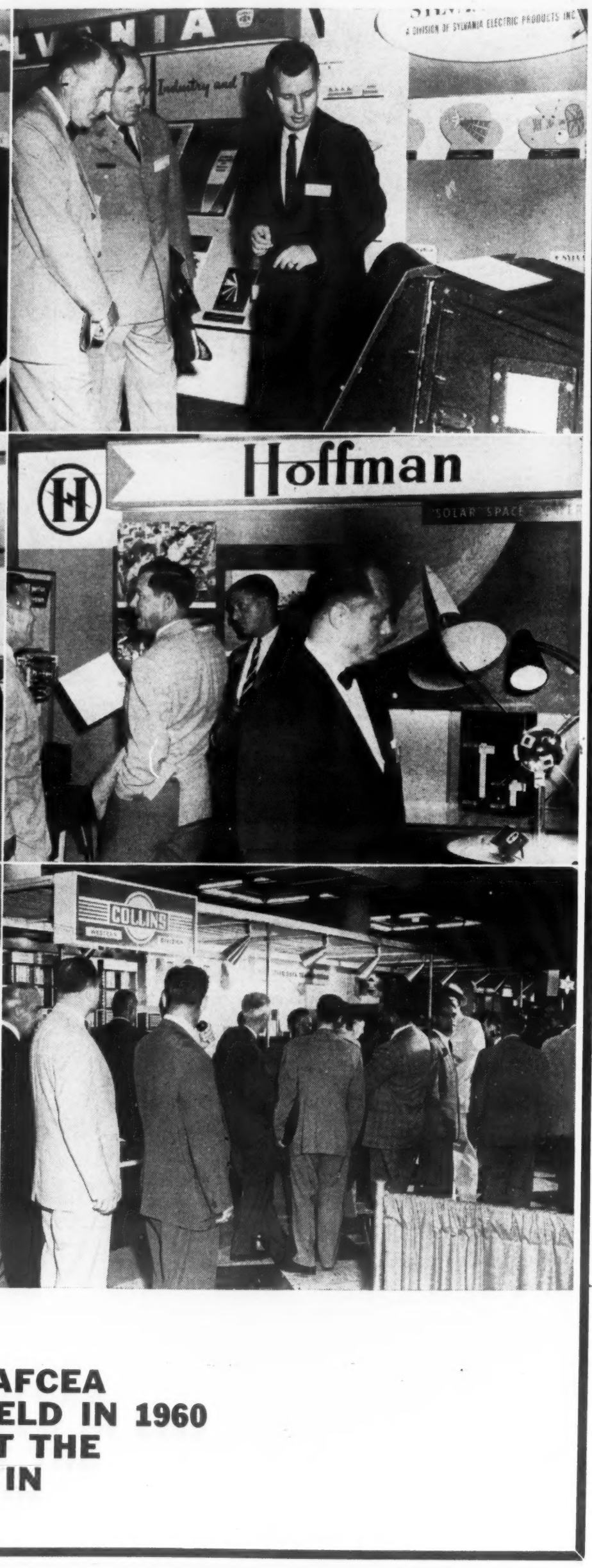
  Personnel familiar with prior facsimile scanning techniques, lauding this new breakthrough in weather facsimile techniques, highly commend these features:

  - ease of copy handling
  - compactness and mobility of equipment
  - quietness and dependability of operation
  - cleanness and sharpness of copy produced

Hi-Altitude Facsimile Weather Drops

will soon be available from American Telephone and Telegraph Co. for qualified companies and organizations. For others interested in facsimile communication systems, Alden Electronics makes flat copy scanner heads and recorders in all sizes and speeds (up to 30 times present network speeds) furnishing components to qualified manufacturers, and complete systems to end customers

We invite your inquiry .



ANOTHER SUCCESSFUL AFCEA CONVENTION WILL BE HELD IN 1960 ON MAY 24, 25 AND 26 AT THE SHERATON-PARK HOTEL IN WASHINGTON, D. C.

Here you see a specially trained North American crew carefully loading a Burroughs computer. Professional crews such as these move electronic computers valued as high as three-quarters of a million dollars each.

Why Burroughs uses North American Van Lines for shipping electronic computers

"Because of North American's superior handling and delivery service, they are awarded a large portion of all shipments of our expensive and delicate electronic computers," asserts W. A. Reed, Traffic Manager, ElectroData Division, Burroughs Corporation.

He goes on to say, "North American's custom floor-to-floor delivery service is especially important in transporting items of this size and weight. Their crews have the necessary equipment and know-how to place the computers exactly where our customers desire. And by using North American's services we can ship our computers almost 100% assembled."

This is just one more example of how North American Van Lines' Kid-Glove handling and complete service all the way eliminates the many problems involved in shipping High Value Products.

Call your local North American agent and get the facts first hand. He'll be glad to talk with you about *your* product moving problems without obligation.

See "Championship Bridge" on TV

Watch North American's exciting new television show featuring Charles Goren and Alex Dreier every Sunday afternoon on ABC-TV—starting Oct. 18.

North American
WORLD-WIDE MOVING
LAND · SEA · AIR

Experts in moving Household Goods, Displays, New Products and High Value Products.

NORTH AMERICAN VAN LINES, Inc. / World Headquarters / Dept. 19-4 / Fort Wayne, Indiana

In Canada, North American Van Lines Canada, Ltd., Pickering, Ontario . . . In Europe, North American Van Lines, Europe, GMBH, Mannheim, Germany

NEW CODE COURSE TESTED AT FORT MONMOUTH

by Lt. Col. Walter White, Jr., USA (Ret.)

STUDENTS OF SECTION 3210, a radio Military Occupational Specialty (MOS) Course, conducted by the United States Army Signal School, Fort Monmouth, New Jersey, are the guinea pigs for a new Radio Code Course based on "reinforced learning" principles.

Instructors at the School are continually looking for new methods of instruction, which will save hours, minutes and even seconds of instructional time. One of the latest experiments in this area relates to the "Sound-N-Sight" course for 19 officer students in Section 3210 at the Signal School.

These 19 students started using the new system on 6 April 1959.

Radio Officer Course

Section 3210 is comprised of United States Signal Corps Officers and Signal Officers from Haiti, Norway and Turkey. The Radio Officer Course which they are taking is designed to train officer personnel to direct and supervise the installation, operation and organizational maintenance of field and fixed station radio equipment. Upon completion of the course, the student is able to accomplish the above and in addition: (1) tune and operate field and fixed station radio equipment and (2) receive and send 6 WPM of International Morse Code.

Although code as a medium of transmitting information is no longer in wide use by the Army, a knowledge of code by repair and officer personnel responsible for high frequency radio teams is essential in an emergency and other situations. Security and intelligence services still make rather wide use of CW transmission and reception. Thus, the era of CW as a transmission means has not passed, even though it has largely been replaced by teletype.

The Radio (MOS) Course runs for 11 weeks (484 hours). Of this time, 37 hours are devoted to code practice and table nets, broken down as follows: one hour introduction to the course; six hours progress tests and examinations; eight hours sending practice and table nets, and 22 hours of receiving practice. Thus, approximately one-third of the course time is devoted to sending practice. Practice sessions are scheduled for one hour per day over a five-day week and each session is actually about 50 minutes long because ten minutes at the end of the hour is used for the standard instructional break and movement to the next class.

The code instructors are former Signal Corps Army Officers who now teach at the Signal School in a civilian capacity. They are Mr. Joseph D. Liga, K2INA formerly, KG6AAB and Mr. Henry G. Bawden, K2GIF/AA-2GIF formerly, W8DSX and MARS Director for the State of New Jersey.

Sound-N-Sight Course

The new course, entitled "Sound-N-Sight" by John F. Rider Publisher, Inc., its sponsor, was developed by 27-year-old education prodigy Lewis Robins in collaboration with Reed Harris, former Deputy Director of the United States Information Agency. Fundamental learning principles underlying the course techniques state that "responses which receive immediate reinforcement are strengthened, responses receiving no reinforcement are extinguished." Rote, or memory training is eliminated by the methods of the course. Removed too, are the "plateaus," the learning blockages which cause difficulty in rising from one code speed to the next higher speed, termed the greatest obstacles to success in radio code instruction to date.

How The System Works

1. The student first hears the correct signal pattern (sound) by which he perceives the difference between dits and dahs. He writes this signal as dots and dashes, such as (- - . -); three seconds later the instructor's voice tells him the pattern was "dah dah dit dah," and the student can immediately tell if he is right or wrong, for reinforcement of his correct responses. This continues through three runs of 52 patterns. Each run is repeated until a passing score of no more than three errors is achieved, as shown on the student's progress chart.

2. He identifies the letter for each signal pattern (sight). Here the student uses the flash identification cards to tie visual patterns to letters, numbers and punctuation marks.

3. He associates sound patterns with letters (sound and sight). The student listens to the pattern, writes it in dots and dashes (- - . -) and in letter form (Q). After each such response the instructor's voice gives him the correct answer, "dah dah dit dah," and the phonetic equivalent "Quebec" for "Q." These runs are repeated until a passing score of three errors or less is achieved on his progress chart. The student takes a three minute break between runs.

After these three abilities have been mastered, the student begins receiving code at three words per minute, increasing his speed by one word per minute per day, until at the end of the novice course he has received eight words per minute. He also learns how to transmit, a skill that comes easily once he has learned to receive.

Student Progress Data

The new method has demonstrated that students progress much faster than with former methods of instruction. For example, after 15 hours of receiving instruction, students of Section 3210 had progressed much faster than all previous classes. At the present rate of progress, it is estimated that the average class speed for both sending and receiving code will be above 13 words per minute after 30 hours of instruction.

The author, recently retired from the Army, is employed in the Electronics Division, Craig Systems, Inc. At the writing of this article he was assigned Chief, Technical Division, Officers' Department, United States Army Signal School, Fort Monmouth, New Jersey.

To gain insight into the progress of this specific group of students, their record is being compared to the records of 200 students in a signal school, who learned code under the old system.

While it is recognized that insufficient students have been tested to make a completely valid statistical comparison between the new and old method, the results to date have been excellent and instructors at the school have expressed confidence in the system. Operational tests will continue for at least another seven classes at which time data will have been collected on a sampling of about 200 officer students.

Occasionally, records of code learning indicate the standing of a student in relation to an arbitrary performance standard, and his progress may not be related to that of students studying with him, or those completing a course at an earlier date. The instructor should always know how a student is progressing compared to others with the same opportunity for learning. This is superior to measurement by an unrelated yardstick.

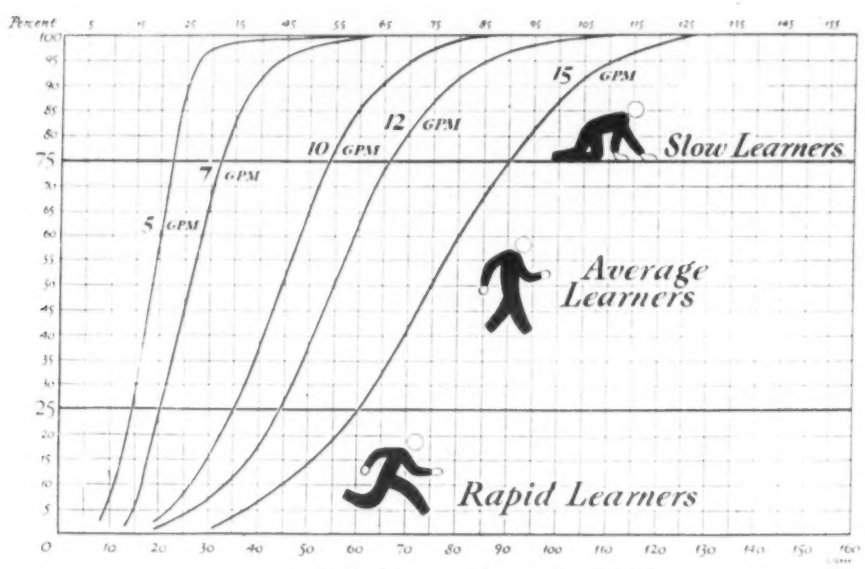
The Signal Corps published a family of curves which represents a cumulative record of code learning from the beginning of practice through 15 GPM. The curves are based on records of 200 men trained in code by the code-voice method with four hours of code practice per day. (See figure 1).

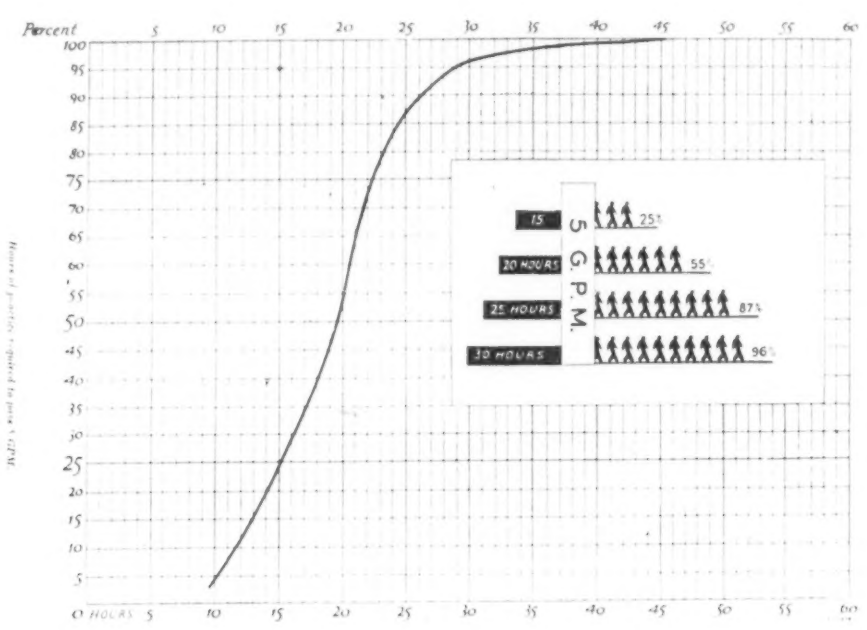
The curve in figure 2 represents the ability of a group of students, under the old system (tape-voice method) to copy correctly at 5 GPM (WPM). Examination of the curve shows that 25% were able to copy 5 GPM correctly after 15 hours, 55% after 20 hours, 87% after 25 hours, and after 30 hours, 96% of the group were able to copy 5 GPM correctly.

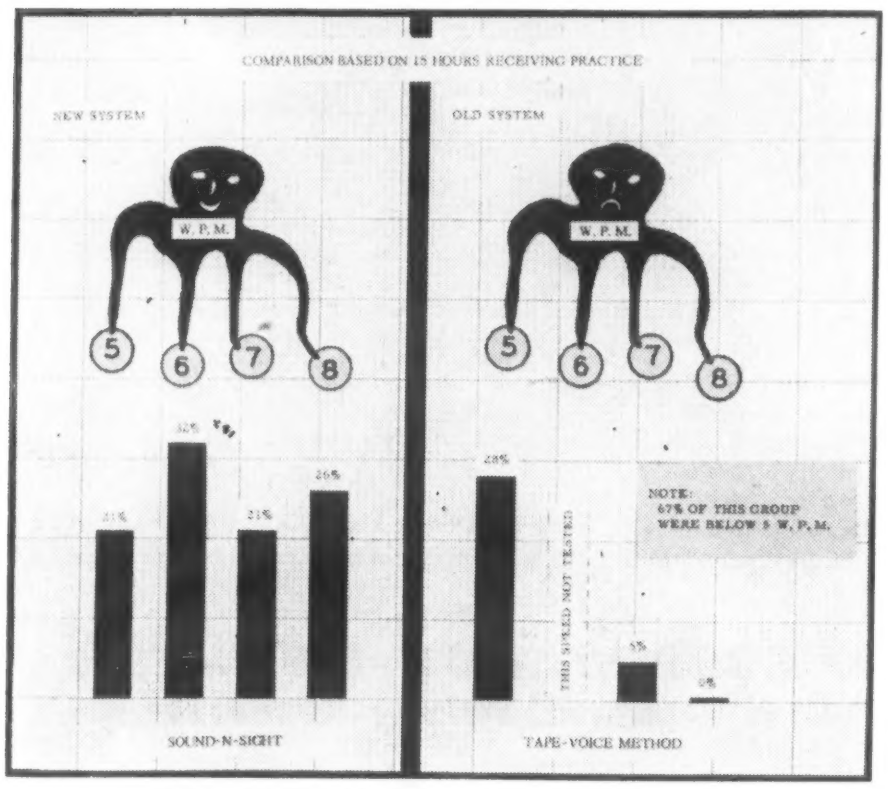
Contrasted with this is the ability of Section 3210. After 15 hours, 100% had passed an examination at 5 WPM (GPM). Of the total group, 21% were on 5 WPM, 32% on 6 WPM and 26% on 8 WPM. The comparison between the records made by students on the new system and the record made under the old system (tape-voice method) is shown in figure 3. This is a bar graph giving a comparison between the two systems. Material for the tape-voice method was obtained from figure 1. The old system does not attempt to grade at increases of 1 WPM as the new system does. Consequently, no data could be derived as to the percentage of students who might be on 6 WPM (GPM). Close examination of the graph shows that it is unlikely that any students were on 8 WPM after 15 hours of receiving practice. It is significant that 67% of the group was below 5 WPM as noted on the right portion of the chart (figure 3).

Figure 4 gives the average speed of the group for each system after 15 hours of receiving practice. Progress of the group has been superior. Mr. Liga, one of the instructors said, "I must admit that I was skeptical at first and I had good reason to be so. Having learned the code in 1943 while a student in the Field Radio Officers Course, and subsequently teaching code to enlisted men and officers, this new method was a radical departure from the conventional learning method.

(*Continued on page* 68)







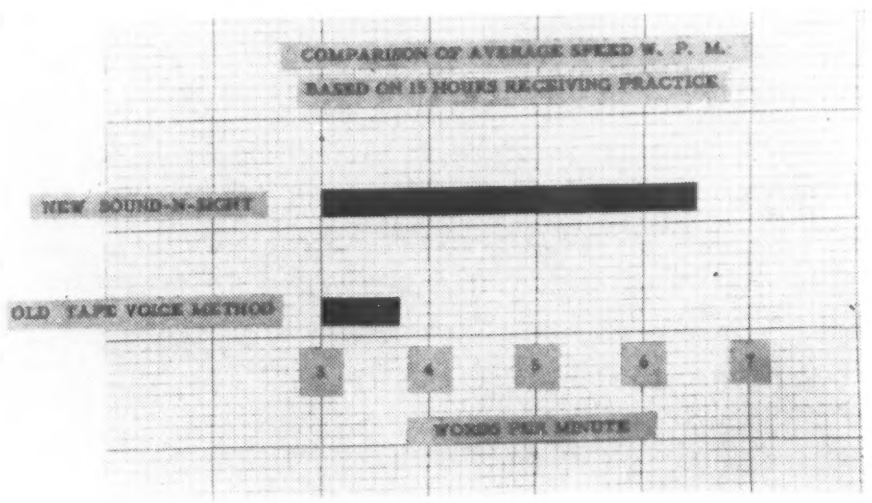


figure 1—top left
figure 2—top right
figure 3—bottom left
figure 4—bottom right

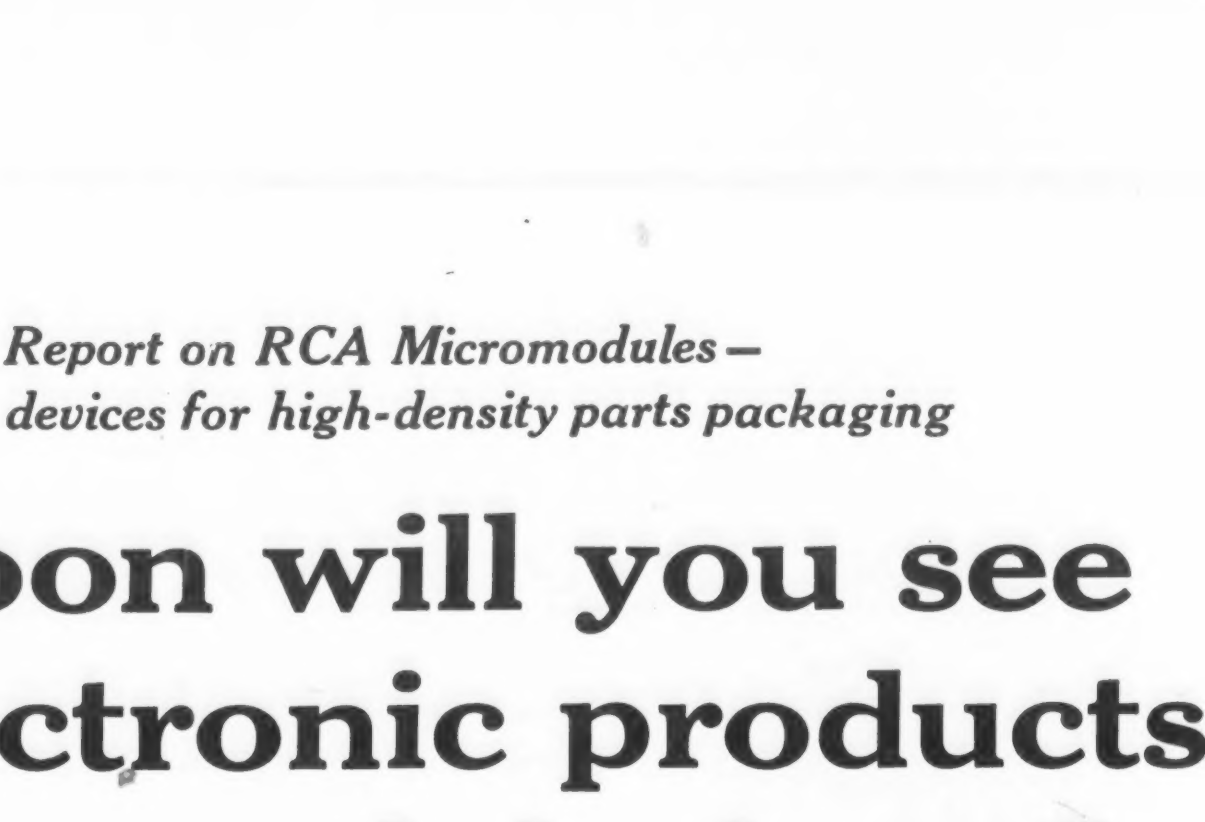
Status Report on RCA Micromodules—
dramatic new devices for high-density parts packaging

How soon will you see your electronic products in Micromodule form?

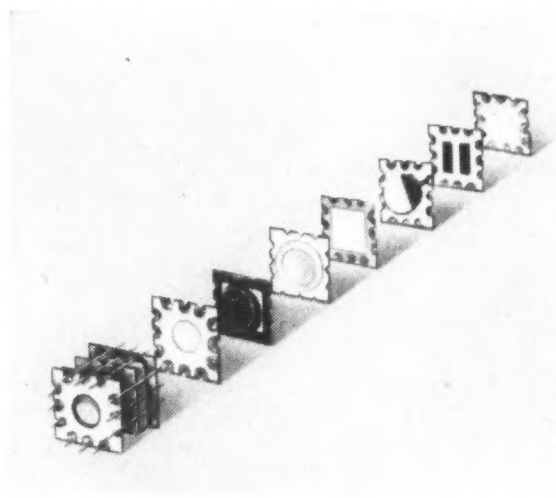
The excitement over Micromodules is still mounting! We haven't seen such enthusiasm and activity since the early days of transistors. Scores of electronic equipment designers and manufacturers are asking: "How soon can I see my product in Micromodule form?" Our answer: *Right Now!* We'll take your circuit, breadboard, or black box, evaluate it and convert it to module form. In fact, you will find that end-equipment in Micromodule form is probably only *one design cycle away!*

Special Presentation Now Ready!

RCA Field Engineers are prepared to show you a presentation that will clearly explain the potentialities and the current working realities of Micromodules for application in military computers, digital devices for missiles and satellites, airborne or portable communication equipment, or submarine electronics. Many designers who have seen this presentation were so impressed with the possibilities of extreme miniaturization and increased reliability of Micromodules that they have immediately placed orders to begin micromodularization of their equipment. Call your RCA Field Representative today and he will set up a presentation for you at your convenience.



RCA Micromodules, todays' most exciting, most practical answer to high-density parts packaging, make possible equipment with modular parts densities to 600,000 per cubic foot. Result: important space savings over existing miniature equipment and an amazing increase in the *number of circuit functions* per cubic foot. Increased reliability through redundancy, room for more circuits to improve accuracy, precision, control and sensitivity are other significant advantages offered to designers.



Micromodules, developed through the joint efforts of RCA and other leading component manufacturers, in cooperation with the U.S. Army Signal Corps, are units in which several microelements are combined to perform specific functions such as amplifier, oscillator, or divider. The microelements are tiny ceramic wafers .310 inches square and 1/100th inch thick, on which conducting, semiconducting, and insulating materials are fused to provide the electrical characteristics of basic electronic components such as resistors, capacitors, and transistors. The microelements are interconnected and encapsulated to form Micromodules.

RCA FIELD OFFICES

East: 744 Broad Street, Newark, N. J.
HUmboldt 5-3900

Northeast: 64 "A" St., Needham Heights 94, Mass.
HIllcrest 4-7200

East Central: 714 New Center Bldg., Detroit 2, Mich.
TRinity 5-5600

Central: Suite 1154, Merchandise Mart Plaza
Chicago, Ill., WHitehall 4-2900

West: 6355 E. Washington Blvd.
Los Angeles, Calif., RAymond 3-8361

Gov't: 224 N. Wilkinson St., Dayton, Ohio
BAldwin 6-2366
1625 "K" St., N.W., Washington, D.C.
DIstrict 7-1260

ALSO AVAILABLE AT YOUR LOCAL RCA SEMICONDUCTOR DISTRIBUTOR

RADIO CORPORATION OF AMERICA
SEMICONDUCTOR & MATERIALS DIVISION • SOMERVILLE, N. J.

PANEL DISCUSSION

A vital part of the 13th Annual AFCEA Convention was the panel discussions in which research and development in various phases of electronics, communications and photography were explored. These discussions by outstanding leaders in industry and the military offered valuable information to their enlightened listeners. The following article is the last in the series published by SIGNAL.

PANEL: *Educational Programs in Electronics*

SPEAKER: *Lt. Col. Edgar J. Masters, USAF, Chief of College and Scientific Education, Air Force Institute of Technology*

ON BEHALF OF THE Dept. of the Air Force, I would like to thank the Armed Forces Communications and Electronics Association for the opportunity to speak at this Convention on the subject of the Air Force Institute of Technology. During the time made available to me, I will briefly give the history of the school, outline its mission and provide more detailed information about the Institute's current programs.

History

The history of the Air Force Institute of Technology will, I am sure, hold considerable interest to this audience. The Institute got underway in the early days of military aviation when the airplane was primarily the concern of the Signal Corps of the Army. In 1919, Colonel Thurman Bane, Commanding Officer of McCook Field, Dayton, Ohio, proposed that the Army establish an aeronautical school. The idea was accepted by the War Dept. and the Air School of Application was founded in November 1919 at McCook Field. Colonel Bane was the first Commandant, and nine officers were enrolled.

The school developed along with Army aviation and in 1926, the name was changed to the Air Corps Engineering School. Subsequent to World War II, the Army convened a board of senior officers to study the problem of officer education. This board recommended that the Air Corps Engineering School be developed into an institution that could provide technical education required by the Army Air Force. In 1946, Dr. Theodore Von Karmen, Chairman of the Army Air Force's Scientific Advisory Board, appointed a committee under the chairmanship of Professor John R. Mark of the Massachusetts Institute of Technology which would study the problem of technical education for officers. The committee recommended than the Army Air Force's Institute of Technology be developed into a school ranking with the better scientific institutions of the country and that the school which was to offer courses in engineering, business administration and logistics should eventually attain a status which would enable it to offer B.S. and M.S. degrees. In 1946, the Army Air Force's Institute of Technology was opened at Wright-Patterson Air Force Base by General Twining, then Commanding General of the Air Materiel Command. In 1948, the Air Force civilian college program was added to the Institute. The resident schools of the Institute developed over the years until the Engineers' Council for Professional Development accredited the undergraduate engineering curricula in 1955. By 1958, the Institute's School of Business was admitted to membership in the American Association of Collegiate Schools of Business. At the present time, the Air Force Institute of Technology grants B.S. and M.S. degrees in business administration. The faculty of the Institute is composed of both military and civilian personnel, the latter being permanent members.

Mission

The mission of the Air Force Institute of Technology is to provide engineering, science, management, medicine, foreign language and other professional education and training, as requested by the Air Force. The education and training are provided through resident schools of engineering, business and logistics and a civil engineering center located at Wright-Patterson Air Force Base, Ohio. The Institute also utilizes civilian schools, hospitals, and industry whenever their institutions can provide for the Air Force's needs. All the programs of study are based upon the professional education and training needs of each Air Force occupational specialty and career field. The Air Force has recently established an Educational Requirements Board to study the educational needs in the various career fields and make recommendations for the kind of professional education required for each. The educational programs of the Institute are voluntary; the Institute publicizes the programs and the officers apply through channels for schooling. In addition to academic qualifications, career intentions as well as past performance and future utilization are considered in making selections.

Current Programs

Programs currently being offered in the Institute's resident schools are shown in figure 1.

In addition to the programs offered in the Institute's resident schools at Wright-Patterson Air Force Base, the following courses are accomplished in civilian institutions. In some instances, specially planned courses have been established for the Air Force; in other cases, the Air Force needs are met through regularly offered university programs. The quotas by field of study, covering B.S., M.S., and some few Ph.D. level courses, are shown in figure 2, page 42.

	Length	*Quota*
Undergraduate Engineering Sciences (Aero-Mech option; Electronics option)	24 mos	44
Graduate Aeronautical Engineering	18 mos	25
Graduate Astronautical Engineering	12-24 mos	21
Graduate Electrical Engineering (Electronics option; Guidance & Control option)	18 mos	40
Graduate Nuclear Engineering	18 mos	20
Graduate Engineering Administration	18 mos	24
Graduate Industrial Administration	12 mos	24
Graduate Comptrollership	12 mos	20
Advanced Logistics	9 mos	30
Special Materiel Short Courses	3-12 weeks	2000
Staff Civil Engineering Course	9 mos	30
Base Civil Engineering Course	9 weeks	140

FIGURE 1

The Instructor Courses are established to prepare officers for duty on the faculty of the Air Academy and at the Institute of Technology. The Short Courses allow the Air Force commands to take refresher work or bring a man up-to-date in various fields where further knowledge is required in his job. All of the other courses given in civilian institutions are designed to prepare officers to carry out more effectively the mission of the Air Force. Most of the programs are professional in nature and are not planned in terms of a given job. Rather, they are designed for service in a particular field involvin the many jobs in the Air Force re quiring such professional competence

The Air Force looks to the Insti tute of Technology to provide officer with professional competence in th many areas in which the officer mus have more than a general knowledg of the service in order to perform hi assigned duty. The rapid change i the weapons systems of the Air Forc and the management responsibilitie inherent in a large organization oper ating world-wide, have greatly in creased the need for personnel wit advanced education. The ability o the Air Force to continue to perform its mission effectively depends to a large extent on the ability of the Ai Force Institute of Technology to pro vide competent officer leaders who can handle the increasingly comple air weapons of the future.

	Length	*Quota*
Engineering	9-24 mos	373
Bio-Physical Sciences	9-24 mos	68
Arts and Social Sciences	9-24 mos	60
Management	9-24 mos	195
Air Academy Instructors	9-24 mos	55
Institute of Technology Instructors	9-24 mos	5
Meteorology	9-24 mos	300
Training with Industry	12 mos	110
Short Courses	3-20 weeks	798
Foreign Languages	1-12 mos	1486
Medical Courses	9-24 mos	724

FIGURE 2

Safety For Tactical Missile Ranges

(*Continued from page* 19)

Each missile range, regardless of locale, is unique within itself. It not only has its own safety problems but another set of safety problems which are common to all ranges. Paradoxically these *common* problems are the ones on which range safety specialization is concentrated.

The problem areas usually treated by writers on Range Safety, and specialized in by range instrumentation contractors, follow roughly the pattern on such safety problems as the following:

1. Local protection of crews and ground facilities in the vicinity of the launching area. This includes protection of personnel from normal missile functions such as blast and booster disposal. It also includes protection from malfunction of missiles, of launching equipment or from abnormal launching deviations caused by personnel errors.
2. Protection of "down range" installations and activities which are along the route of missiles in flight and are therefore vulnerable to "overs" and "shorts."
3. Protection of the general public and persons living or working outside but near range boundaries. (Safety zones included *inside* range boundaries to give the maximum physical insulation possible.)
4. Protection of people from accidentally straying into danger areas. On missile ranges covering millions of acres, this involves keeping individuals from unintentional trespassing on foot, on horseback, in cars and in private airplanes. In some areas, cattle wandering onto ranges can become a safety problem.
5. Keeping "in flight" missiles under positive control and within established safety boundaries; or destroying the missile (safely) if it should veer off range. (This last problem *always* involves communicating with the missile in one way or another.)

These five common problems beset different range safety officers to differing degrees. And obviously the physical location of a given range will influence the degree of emphasis necessary to solve any one of the five problems. Nor are the five outlined above the only common missile range safety problems by any means. They are mentioned only to illustrate the contrast between general and special (or unique) range safety problems with which all missilemen are faced to varying degrees.

In addition to the safety problems common to all mis sile ranges, there are of course special problems which are associated with a particular locale or with a particu lar range's operational mission. Special range safety in strumentation is therefore influenced in a large measure by such special considerations as:

a. Whether the range is a Research and Development missile range which must be instrumented to cover the whole span of performance factors for each individual missile; or whether it is a test range for testing only a few components of a missile system or for testing whole systems, or a number of different systems.

b. Whether the missile systems being fired at that point are merely vehicles to propel objects for non-missile programs. (Such as a missile system to hurl satellites into orbit.) The volume of fire (i.e. the number of missiles per day, per week, etc.) is also an important factor in range safety.

And then, of course, there are all combinations of the factors outlined above. Like the safety problems common to all missile ranges. these special safety problems confront the missilemen in varying degrees of urgency for solution.

In addition to the special problems related to the mission of the several types of ranges in the R&D field, there are a few rather mundane range safety problems related to some purely physical factors such as:

1. Proximity of range boundaries or launching areas to heavily traveled highways.
2. Proximity of ranges to air space through which air traffic density is a consideration since the advent of homing type missiles.
3. Topographic contour of both on range and surrounding off range geography, since this will influence how far a radar can "see" and how many radio and microwave relays will be required for control and safety purposes.

All of these general and special safety problems are shared by all R&D type ranges and are the basis for the recent specialization in range safety. And, in the humble opinion of this writer. there is still plenty of room in the range safety field for the best efforts of the Armed Forces-Industry team to be expended productively.

4 ESSENTIAL CONSIDERATIONS—

in the purchase of a facsimile chart recorder

READABILITY:

The clarity and sharpness of "Weatherfax" is unequalled by any other direct facsimile recording.

SIMPLICITY AND ECONOMY:

"Weatherfax" uses continuous roll of "dry" electro-sensitive low cost paper not affected by light, heat or unusual storage conditions. Automatic in operation. It will record a total of 5 days continuously, unattended, with resulting saving in both material cost and personnel time.

RELIABILITY OF MANUFACTURE:

Dependability of performance has always been a feature of Times Facsimile equipment from a "Top Hat" Tube Retainer to "Weatherfax." Experienced engineering and excellence of material and workmanship dating back to 1922, offer assurance of continued reliability and satisfaction.

FAST EXPERIENCED SERVICE:

As the largest supplier of weather map facsimile recorders, Times Facsimile is able to provide immediate maintenance through its nation-wide service organization of electronic specialists.

A portion of the map in actual size showing excellent clarity and detail.

WEATHERFAX

Quality in performance
Quality in economical dependability
Quality in maintenance organization

Write for details.

TIMES FACSIMILE CORPORATION

A DIVISION OF LITTON INDUSTRIES

540 West 58th Street • New York 19, N. Y.

Signalgram *(Continued from page 22)*

GENERAL

THE BEST PRIZE WINNERS of the International Advertising Film Festival, held in Cannes during June, were shown last week during the Industrial Film & A-V Exhibitio at the Trade Show Building in New York City. Featuring publicity films for the theatre and television commercials, the special showing consisted of the most outstanding films from France, Belgium, Denmark, U.S.A., Italy, Switzerland, England, Holland, Spain, South Africa and Germany.

ARRL FIELD DAY high claimed scores from the June event are being compiled now by th American Radio Relay League. A partial listing in the October issue of QST shows that in Class D—Emergency-Powered Home Stations, W4NPT led with a score of 546. I Class E—Commercial-Powered Home Stations, KOLIR led with a score of 535. Final results will be available in December.

AT THE ARMY NAVY INSTRUMENTATION PROGRAM SYMPOSIUM recently conducted in Dallas, some of the items demonstrated included: a dynamic helicopter flight simulator and instrument systems making possible safe, all weather helicopter flights, new airborne digital computers and a series of advanced cockpits. Directed by the Office of Naval Research, Bureau of Aeronautics and Army Signal Corps, ANIP was formed six years ago to provide an R&D program for the integrated presentation of flight information for fixed wing and rotary wing aircraft.

WAYS OF SOLVING RF ALLOCATION PROBLEMS were noted by American and Soviet delegates at the 1959 International Telecommunications Union Administrative Radio Conference, held recently in Geneva. According to Electronic News, the chief of the U.S. delegation seconded a Soviet proposal authorizing that a subcommittee of the conference study techniques for promptly listing all frequency allocations as well as frequency registration procedure.

AMERICA'S LARGEST and the world's second largest dish antenna, as tall as a 15-story building, will appear on the campus of Stanford University in about a year. The dish will be a "radar telescope" with a parabolic reflector 142 feet in diameter. A 20-60 mc radio transmitter—the most powerful ever built in this frequency range and requiring a million-watt power supply—will be installed near the dish, making the combined installation a new and sensitive tool for space research, and enabling scientists to bounce signals against heavenly bodies. The project will be a joint undertaking by SRI's Communication and Propagation Lab. and the University's Radio Propagation Lab. with support from the Air Force Cambridge Research Center.

AN INCREASE OF JAPANESE ACTIVITIES IN THE TRANSISTOR FIELD is noted as the Cornell-Dubilier Electric Corp. announced that it has completed negotiations with the Toshiba Co. of Japan to form a new, international manufacturing-distribution association to market the Japanese transistors in the U. S.

TURKEY AND PUERTO RICO are the sites of two new signal communications agencies established by the U. S. Army Signal Corps to increase the capabilities of the world-wide Army Command and Administrative Network. Located at Ankara, Turkey, the U. S. Army Asia Minor Signal Agency replaces a small detachment of the U. S. Army Middle East Signal Communications Agency. The U. S. Army Caribbean Signal Agency is in operation at Fort Allen, Puerto Rico.

CALENDAR OF EVENTS:

OCTOBER 12-14: National Electronics Conference, Hotel Sherman, Chicago, Ill.; sponsored by American Institute of Electrical Engineers, Illinois Institute of Technology, Institute of Radio Engineers, Northwestern University and University of Illinois.

OCTOBER 14: Meeting of the Institute of Printed Circuits, Sheraton Towers, Chicago, Ill.; panel discussions; meeting open to IPC members and guests.

OCTOBER 15-16: Quartermaster Association National Convention, Statler Hilton, N. Y.

OCTOBER 16-22: International Congress on High-Speed Photography and Technical Conference of the Society of Motion Picture and Television Engineers, Sheraton-Park Hotel, Washington, D. C.: simultaneous interpretation of technical sessions into English, French and German provided through individual headset radio receivers.

OCTOBER 26-30: Society of Photographic Scientists and Engineers National Conference, Edgewater Beach Hotel, Chicago, Ill.; Armed Forces exhibits authorized by Defense Department.

RECORD TELEVISION PICTURES ON TAPE

AMPEX VIDEOTAPE* TELEVISION RECORDER

The simplicity of tape recording is brought to closed circuit television applications with the Ampex VR-1000B. Picture and sound, or 4,000,000+ cycle data are recorded with advantages not available with film or other data-recording media.

IMMEDIACY The picture being recorded—either from a direct or beamed signal from the television camera—can be monitored as it is recorded. Moments later, when rewound, the tape can be replayed on the TV monitors.

SECURITY You record, duplicate and play back your recording, independent of any outside service. And the recordings can be sent at your discretion to any other Ampex equipped facility for playback.

SAFETY The Recorder can be placed in a safe, remote location, completely removed from the television camera. The success of the recording is not conditioned by the safe return of the camera.

LIVE QUALITY The complete grey scale is captured. Video playbacks look "live". There are two separate audio channels simultaneously recorded on the same tape for auxiliary data or sound.

SIMPLICITY 96 minutes of both picture and sound can be recorded on a reel of 2-inch wide magnetic tape.

ECONOMY Full color recording can be made on the same tape used for black and white, requiring only the addition of a single electronics rack. **Tape recording is less expensive than any other recording media.**

ULTRA-HIGH RESPONSE
DATA RECORDER The Ampex Videotape Television Recorder is not limited to television recording. It will record electronic signals ranging from 0 to more than 4,000,000 cycles/per/sec. storing up to a million bits of information in less than 4 inches of tape, 2 inches wide.

Graduate engineers, thoroughly versed in government and military applications and procedures are available at Ampex to answer your questions. Address inquiries to Department 304-1. A booklet "Advanced Applications" and a technically complete brochure "VR-1000B" are yours for the asking.

934 CHARTER ST. • REDWOOD CITY, CALIF. • EMERSON 9-7111
Offices and Representatives in Principal Cities Throughout the World

VIDEOTAPE™ AMPEX CORPORATION *professional products division*

*TM AMPEX CORP.

Association affairs

AFCEA

1624 Eye Street, NW
Washington 6, D. C.
Phone: EXecutive 3-3033

OFFICERS

President
Benjamin H. Oliver, Jr.*
1st Vice President
Rear Adm. Frank Virden, USN*
2nd Vice President
Maj. Gen. Harold W. Grant, USAF*
3rd Vice President
Maj. Gen. R. T. Nelson, USA*
4th Vice President
John W. Inwood
5th Vice President
Ben S. Gilmer
General Counsel
Frank W. Wozencraft
General Manager
W. J. Baird
Secretary
Julia B. Godfrey
Treasurer
W. Earl Trantham
Immediate Past President
Frederick R. Furth*

DIRECTORS

1960

Francis L. Ankenbrandt
Percy G. Black
Theodore S. Gary
John J. Hanselman
Charles F. Horne*
David R. Hull
J. Harry LaBrum
David Sarnoff

1961

Harry E. Austin
Roland C. Davies
E. K. Foster
Francis H. Lanahan
Joseph R. Redman
Robert C. Sprague
W. W. Watts
Frank W. Wozencraft

1962

George W. Bailey
Theodore L. Bartlett
Maj. Gen. Gordon A. Blake, USAF
Ben S. Gilmer
Joseph E. Heinrich*
John R. Howland*
Fred E. Moran
Donald C. Power

1963

Leonard D. Callahan
Brig. Gen. A. F. Cassevant, USA
Walter C. Hasselhorn
Walter P. Marshall
Henry J. McDonald*
A. L. Pachynski
William L. Roberts
Ellery W. Stone

The President, the immediate Past President, the Vice Presidents and the Counsel are ex-officio members of the Board of Directors.
**Executive Committee Member.*

Brig. Gen. Elmer L. Littell, Commanding General, USASSA, (right) and Frank Langstroth, president, Philadelphia Chapter, (center) look on as Maj. Francis J. Walush displays a list of new AFCEA members at the Agency.

88 New Philadelphia Members

"Project AFCEA Membership" was successfully accomplished at the U.S. Army Signal Supply Agency, Philadelphia recently. It resulted in the enrollment of eighty-eight of its personnel as new members of the Philadelphia Chapter of AFCEA.

In the true sense of the words, this was neither a "campaign" nor a "drive." It was a friendly, no-pressure approach directed by Brigadier General Elmer L. Littell, Commanding General of the Agency, who is also a vice president of the local AFCEA Chapter. "Chief of Operations," appointed by the General, was Major Francis J. Walush, Assistant Deputy for Quality Assurance. Assisting the Major were coordinators in all Agency activities. "Volunteer" aid came from Bernard Pear, president, and the late Edward Farrell, vice president, of the Executive Association.

Publicity in all its aspects was one of the tools employed. Personal contact and literature called attention to the objectives of AFCEA. The dates of forthcoming meetings were announced at staff meetings on bulletin boards and on the blackboard at the building's entrance.

AFCEA Directors Meet

On September 17, 1959, our National President, Colonel Benjamin H. Oliver, Jr., called to order the meeting of the National Directors at the Army and Navy Town Club, Washington, D. C.

Prior to the meeting, the Executive Committee met at the Hughes Aircraft Company (HAC), 1612 K St., N.W., Washington, D. C. The facilities of HAC were made available through the courtesy of W. Earl Trantham, Manager, East Coast Operations, Hughes Products Group, and our National Treasurer.

The Directors, among other actions, approved a proposal submitted by National President Oliver to change the fiscal year from April 1-March 31 to September 1-August 31.

General Manager and Editor W. J. Baird discussed a program for the advancement of AFCEA during the next twelve months. Colonel Baird offered several suggestions for increasing the number of sustaining, group and individual memberships and outlined certain projects which the Directors could undertake to assist National Headquarters.

To fill the two existing vacancies on the Executive Committee, the Directors elected Charles F. Horne, Manager, Convair, Calif., and Henry J. McDonald, Secretary and General Counsel, Kellogg Switchboard and Supply Co., Chicago.

National Treasurer Trantham pre-

(*Continued on page* 48)

NEW MEMBERS

Listed below are new members of the AFCEA who joined the Association during the month of August. Members are listed under the Chapter with which they are affiliated. The September listing will appear in the November issue.

Atlanta

Jack Y. Anderson
Charlie A. Hansard

Augusta-Fort Gordon

Capt. Walter T. Zamojc
Capt. Robert G. Caudle, Jr.
Lt. Glenn H. Pless
Capt. Elmer T. Kinkade, Jr.

Baltimore

Jack E. Lewis
Frank R. Swoger

Boston

Norman Waks

Chicago

Cdr. Theodore S. Stern
Stephen P. Kostyal
J. F. Sullivan
Cameron Byrne
W. Peugh
Dr. Robert Beam
B. Welch
H. Schulman
Ralph C. Close
Charles R. Mann
A. Pope Lancaster
Maurice R. Robinson
F. W. Traeger
E. J. Skeppstrom
Charles T. Baumgart
Lt. Col. Leo R. Jensen

Fort Monmouth

Lt. Col. James A. McClung
Lt. Robert F. Roycroft

Gulf Coast

Anthony F. Palmieri
Henry W. Stephens
James R. Roth
James L. Nelson
M-Sgt. Robert M. Malone
Capt. Bernard F. Hauk

Lexington

Maj. Joseph E. Brown
Lt. Col. Darwin A. Brock

London

Lt. Jack W. Bornejko

New York

Morton Lashy
Lt. Col. Raymond J. Fening
William Rauscher
B. S. Bomhoff
Walter A. Knoop
Lindley Myles, Jr.
H. W. Dewitt
F. M. Pastore
J. D. Debutts
A. M. Rouse
J. J. Collins
G. J. Carmichael
E. G. Guillet
J. J. Murphy
A. S. Mayo
B. H. Nelson
Pierce M. Maher
John A. Bowman
Ronald G. Caravello
Salvatore C. Spataro
Joseph P. Leary
Hilda S. Shevack
Stanley Rosenberg
Edward Waldman
Samuel Sacks
George Brown

North Carolina

Lt. Col. Paul Van Sloun
Edwin A. Clement
Edward L. George
Aaron H. Cobb

Northeastern University

William F. Fratus
John J. Todd
Matthew H. Cohn

Northwest Florida

Brig. Gen. Milton H. Ashkins
Rear Adm. Joseph M. Carson
Roland C. Gessert
Cdr. Lawrence D. Egan
Vice Adm. Charles P. Mason
Wesley E. Jackson

Orange

Louis P. Clark, Jr.
Dr. Charles R. Burrows
Hans Scharla-Nielsen

Paris

Capt. John R. Wadleigh
Pierre F. Mome

Philadelphia

William K. Kreamer
Charles J. Leis
Col. Douglas O. Toft
Harvey R. Oakley
Ronald J. Gibson
John M. Volpe
John F. Maguire
Vincent A. Ciammaichelli
Ernest J. Mooshian
Stuart L. Calhoun
Edgar A. Jolley
Leo Shapiro
Bernard Pear
Lee B. Steele
James C. MacDonough
John W. Sabin
Lilian K. Levinsky
Lynn H. Drake
James A. Farley
Estelle R. Paul
Robert J. Gault
Michael L. Diorio
Joseph Bergman
Isabelle Scott
Meyer Benedict
A. Gordon Tomlin
David M. Smith
J. Kenny
T. Redington
Louis Donsky

Rocky Mountain

Dwaine A. Nielson
Lloyd L. Leger
Charles W. Jackson
A. David Miller

Rome (Italy)

Capt. John G. Nash
Leonetto Bianucci

Rome-Utica

J. F. Wilson
Charles L. Race
Henry L. Dinerstein
Stuart A. Wagner
Humbert F. Derosa
Patsy A. Damanda
Theodore P. Broskay
Charles M. Hope
Thomas Z. Corless
Maj. Paul F. Pomeroy
Stephen L. Kovach
Capt. John F. Wildman

San Francisco

William C. Holmes
Shirley L. Small

San Juan

Gilberto Abraham

Santa Barbara

Elmer H. Whittaker
Dennis A. Marlow

South Carolina

Henry A. Miller

Southern California

B. D. Reedy
George Moore
Roger Grimes
Douglas F. Stevens
G. N. Mayer
Alfonzo J. Izzo

Southern Connecticut

George W. Oehlsen

Tinker-Oklahoma City

Lt. William S. Flanigen
Capt. Victor W. Cadwell

Tokyo

Allen F. Manley
Walter H. Kreamer
Col. John F. McCarthy

Washington

Robert L. Lannen
Col. Horace M. Wood
Harold Roher
Francis C. Ennis

New members without chapter affiliation

R. M. Burke, Albany, N. Y.
S. W. Cooper, Albany, N. Y.
A. L. Rumsey, Albany, N. Y.
R. W. Scofield, Albany, N. Y.
M. A. Mace, Syracuse, N. Y.
D. L. Clark, Rochester, N. Y.
D. W. Burns, Rochester, N. Y.
H. C. Briggs, Cedar Rapids,
Ralph Ackerman, Janesville, Wisc.
J. E. Clark, Buffalo, N. Y.

Association Affairs

(*Continued from page 46*)

sented a detailed review of Association finances which included the proposed cash budget for the coming year. The meeting terminated with a discussion of plans for the 1960 Convention.

The following Directors attended: Francis L. Ankenbrandt, George W. Bailey, Theodore L. Bartlett, Percy G. Black, Brigadier General A. F. Cassevant, USA, Roland C. Davies, E. K. Foster, Ben S. Gilmer, John J. Hanselman, Walter C. Hasselhorn, Charles F. Horne, David R. Hull, Francis H. Lanahan, A. L. Pachynski, Joseph R. Redman, William L. Roberts, Ellery W. Stone and Frank W. Wozencraft.

The following Executive Committee members (also Directors) were present: President Benjamin H. Oliver, Jr., Immediate Past President Frederick R. Furth, Major General Harold W. Grant, USAF, Joseph E. Heinrich, John R. Howland, Lieutenant Colonel Kenneth E. Shiflet (representing Major General R. T. Nelson, USA) and Rear Admiral Frank Virden, USN.

The Association was pleased to have the following Regional Vice Presidents attend the Directors Meeting: Glenn D. Montgomery, of Region A, George C. Ruehl, Jr., of Region B-1, and Walter H. Pagenkopf of Region E.

Representing National Headquarters were W. J. Baird, Frank Ostenberg, Julia B. Godfrey, W. Earl Trantham and Frank Martins.

Chapter To Change Name

As requested by the Board of Directors of the Southern California Chapter, National Headquarters has approved the Chapter's recommendation to change its name to the Greater Los Angeles Chapter. The action will become effective July 1, 1960.

Honorary Member

General Lyman L. Lemnitzer, Army Chief of Staff, has accepted the Association's invitation to become an honorary member of AFCEA during his term of office as Chief of Staff, U. S. Army. In accepting, General Lemnitzer stated, "It would be a pleasure for me to join your membership and I am happy that I can accept."

New Group Members

Ling-Altec Electronics, Inc.

Ling-Altec Electronics, Inc., of Anaheim, Calif., a manufacturer of environmental testing systems, sonar and acoustics, is a new group member.

Company representatives include: C. G. Pierce, President; A. A. Ward, President, Altec-Lansing, Inc.; R. F. Martin, Vice President and General Manager, Ling Electronics Div.; C. Theodore, Vice President, Sales, Ling Electronics Div.; J. A. Ross, Vice President, R&D, Ling Electronics Div.; P. S. Goodwin, Chief Engineer, Ling Electronics Div.; A. B. Ostroski, Military Liaison Engineer, Ling Electronics Div.; J. K. Hilldard, Vice President and Advanced Engineer, Altec-Lansing Inc.; J. O. Weldon, President, Continental Electronics Div.; L. H. Carr, President, Developmental Engineering Corp.

Telectro Industries Corp.

Telectro Industries Corp. has become a group member. Manufacturers of electronic equipment, the company is located in Long Island, N. Y.

Company representatives are H. Sussman, President; S. Rosenberg, Secretary-Treasurer; E. Waldman, General Manager; S. Sacks, Engineering Director; G. Brown, Chief Engineer.

Chapter Activities

With most AFCEA chapters recessed during the summer months, there was little chapter activity to report in this issue. Regular chapter meetings resume in the fall and the subsequent issues of SIGNAL will again carry complete Chapter News.

A few chapter items of interest since the September issue are:

Gulf Coast—Lt. Col. Everett G. Reed, USAF, chapter president, was recently transferred to New York. Succeeding him as head of the chapter is Lt. Col. Paul C. Kiefer, USAF, formerly vice president.

Paris—Rear Admiral H. C. Bruton, Director of Communication-Electronics, Headquarters U. S. European Command, the newly-elected president of the chapter, addressed the chapter's June meeting on the subject of "Sea Power for Freedom."

Santa Barbara—The chapter met at Point Mugu on July 24th for a conducted tour of the facility. Speaker of the evening was Lt. Cdr. Ray Meyers, USN(Ret.), AFCEA Regional Vice President for the West Coast, who gave his first-hand report of the first attempt by a submarine to cross beneath the polar ice cap back in 1931. Films from that voyage, together with films of the most recent voyage by the *Nautilus* atomic-powered submarine, were shown.

Tokyo—New officers for the coming year are: president—Col. Bradford H. Wells, USAF; vice presidents—Lt. Col. George H. Darwin, USA; Donald A. Hughes, Philco Corp.; and Cdr. Harold B. Kirkham, USN; secretary-treasurer—Maj. Robert G. Ramsey, USAF.

Free
send for the most widely used
ELECTRONIC SUPPLY GUIDE
ALLIED'S
1960 CATALOG
BUY AT FACTORY PRICES
WORLD'S LARGEST STOCKS AT YOUR COMMAND
ALLIED RADIO
ELECTRONICS
1960
specialists in the complete supply of:
• Semi-Conductors • Special-Purpose Tubes • Controls, Resistors
• Connectors • Test Equipment & Meters • Switches & Timers
• Relays • Knight-Kit® Instruments • Knight® P.A. Equipt.
• Transformers • Electronic Parts for Every Industrial Need
ONE ORDER TO ALLIED FILLS THE WHOLE BILL: Your ALLIED Catalog is the best single source for electronic supply. It puts the world's largest stocks at your command—there's no need to deal with hundreds of separate factories—one order to us fills the whole bill. You get same-day shipment (fastest service in electronic supply) and you buy at factory prices. Send today for your FREE 1960 ALLIED Catalog—your one-source electronic supply guide.
your dependable direct factory source for everything in electronic supply
ALLIED RADIO
100 N. Western Ave., Dept. 97-K9
Chicago 80, Ill.
our 39th year
send for FREE catalog

AFCEA CHAPTERS AND CHAPTER OFFICERS

REGIONAL VICE PRESIDENTS

Region A: G. D. Montgomery, AT&T Co., 32 Ave. of the Americas, New York, N. Y. ***New England States, New York, New Jersey.***

Region B1: George C. Ruehl, Jr., 2118 St. Paul St., Baltimore Md. ***Delaware, District of Columbia, Maryland, Eastern Pennsylvania and Virginia.***

Region B2: Paul H. Clark, Radio Corporation of America, 224 N. Wilkinson St., Dayton, Ohio. ***Kentucky, Ohio, West Virginia and Western Pennsylvania.***

Region C: W. K. Mosley, Southern Bell T&T Co., Hurt Bldg., Atlanta, Ga. ***Southeastern States along Atlantic and Gulf coasts—from North Carolina to Louisiana including Tennessee.***

Region D: Maj. Gen. Harry Reichelderfer, USA (Ret.), Southwest Research Institute, 8500 Culebra Rd., San Antonio, Tex. **New Mexico, Texas, Oklahoma, Arkansas.**

Region E: Walter H. Pagenkopf, Teletype Corp., 5555 Touhy Ave., Skokie, Ill. ***Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, North Dakota, South Dakota, Wyoming, Colorado.***

Region F: Ray E. Meyers, 717 Anderson Way, San Gabriel, Calif. ***Arizona, Utah, Nevada, California, Idaho, Oregon, Montana and Washington.***

CHAPTERS: PRESIDENTS AND SECRETARIES

ARIZONA: Pres.—Lt. Col. Wm. M. Coeyman, 4015A Grierson, Ft. Huachuca, Ariz. Sec.—Samuel M. Dyer, P.O. Box 2758, Ft. Huachuca.

ATLANTA: Pres.—A. E. Arnold, Western Union, 48 Marietta St., N.W., Atlanta, Ga. Sec.—A. M. Wilson, Southern Bell T&T Co., 51 Ivy Street, N.E.

AUGUSTA-FORT GORDON: Pres.—Col. Robert R. Creighton, Hq. USA SESCS, Ft. Gordon, Ga. Sec.—Lt. Col. Ollie J. Allen, USASTC, Ft. Gordon.

BALTIMORE: Pres.—J. Walter Colvin, Bendix Radio Div., Towson, Md. Sec.—Ray Moore, Hoover Electronics Co., Timonium, Md.

BOSTON: Pres.—Col. Sidney S. Davis, PMST, Northeastern University, Boston, Mass. Sec.—William Melanson, Cambridge Thermionics Corp., 447 Concord Ave., Cambridge.

CENTRAL FLORIDA: Sec.—Russell R. Randell, 208 So. Manhattan Ave., Tampa, Fla.

CHICAGO: Pres.—William L. McGuire, Automatic Electric Co., Box 35, Northlake, Ill. Sec.—Sandford Levey, Allied Radio Corp., 100 N. Western Ave., Chicago, Ill.

DAYTON-WRIGHT: Pres.—William H. Shade, General Mills, Inc., 2600 Far Hills Bldg., Dayton. Sec.—Cecil Hill, General Electric Co., 333 W. 1st St., Dayton.

DECATUR: Pres.—Lt. Col. Robert A. Starr, Decatur Signal Depot, Decatur, Ill. Sec.—Edward J. Maloney, 60 Northland Dr., Decatur, Ill.

FORT MONMOUTH: Pres.—Norman K. Freeman, 84 Bay Ave., Atlantic Highlands, N. J. Sec.—Harry C. Ross, Box 249, Hillside Rd., Atlantic Highlands, N. J.

FRANKFURT: Treas.—Ralph L. Prokop, USA Procurement Center, APO 757, N. Y.

GULF COAST: Pres.—Lt. Col. Paul C. Kiefer, Keesler Tech. Trng. Center, Keesler AFB, Miss. Sec.—Donald H. Presley, Southern Bell T&T Co., Gulfport.

GREATER DETROIT: Pres.—Maj. Carl L. Lisbeth, C&E Staff, Hq. 30th Air Div., Belleville, Mich. Sec.—J. R. Saxton, Michigan Bell Telephone Co., 305 Michigan Ave., Detroit.

HAWAII: Pres.—Robert Lowrey, Hawaiian Telephone Co., Box 2200, Honolulu, T. H. Sec.—Francis Medeiros, Hawaiian Telephone Co., 1130 Alakea Street, Honolulu, T. H.

KANSAS CITY: Pres.—William E. Fisher, SW Bell Tel Co., 324 E. 11th St., Kansas City, Mo. Sec.—Charles E. Sevier, SW Bell Tel Co., 324 E. 11th St., Kansas City.

KOREAN: Sec.—William L. Wardell, OEC, RD-CD, APO 301, S. F.

LEXINGTON: Pres.—Raymond Soard, Jr., General Tel. Co., 151 Walnut St., Lexington, Ky. Sec.—Waddy Neubauer, 201 Romany Rd., Lexington, Ky.

LONDON: Pres.—Col. Joseph A. Plihal, Hqs. Third Air Force (30CE), APO 125, N. Y., N. Y. Sec. Lt. Col. Richard F. Amann, 3rd Comm. Group, APO 125, N. Y., N. Y.

LOUISIANA: Pres.—Wesley P. Massey, New Orleans Pub. Svce., 317 Baronne St., New Orleans, La. Sec.—A. Bruce Hay, Southern Bell Tel. & Tel. Co., 520 Baronne St., New Orleans.

MONTGOMERY: Pres.—Lt. Col. Herbert Herman, Air Command & Staff College, Maxwell AFB, Ala. Sec.—Luther L. Hall, 703 Belvedere Drive, Montgomery, Ala.

NEW YORK: Pres.—Henry R. Bang, New York Telephone Co., 140 West St., New York 7, N. Y. Sec.—Thomas Brown IV, New York Telephone Co., Rm. 2011, 140 West St., New York 7, N. Y.

NORTH CAROLINA: Pres.—Col. Ray Bagley, 1st Log. Cmd, Fort Bragg, N. C. Sec.—John C. Coley, Carolina T&T Co., 517 Hay St., Fayetteville.

NORTH TEXAS: Pres.—Thomas F. Byrnes, AT&T Co., 212 No. St. Paul St., Dallas. Sec.—Robert J. Novak, AT&T Co., 212 No. St. Paul St., Dallas.

NORTHEASTERN UNIVERSITY: 360 Huntington Ave., Boston 15, Mass. Div. A: Pres.—Richard Dwyer; Div. B: Pres.—Harry Giberson.

NORTHWEST FLORIDA: Pres.—Sam Love, Jr., Southern Bell T&T Co., Pensacola, Fla. Sec.—Lt. Col. Leroy T. Souders, P. O. Box 302, Shalimar, Fla.

ORANGE: Pres.—Maj. Morris Muse, USAF, Hq. Air Rescue Service, Orlando AFB, Fla. Sec.—Lt. Col. James A. Trutter, Radiation Inc., P.O. Box 6904, Orlando, Fla.

PARIS: Pres.—Rear Adm. Henry C. Bruton, Hq. US EUCOM, C-E, APO 128, New York. Sec.—Lt. Col. Philip H. McCorkle, Hq. US EUCOM, Comm-Elect., APO 128, New York.

PHILADELPHIA: Pres.—Frank D. Langstroth, Philco Corp., 4700 Wissahickon Ave., Philadelphia, Pa. Sec.—Conrad Young, Philco Corp., 4700 Wissahickon Ave., Philadelphia.

PHILIPPINE: Pres.—Lt. Col. Sidney A. Goldman, 1961st AACS Sqdn, APO 74, S. F.

PITTSBURGH: Pres.—Edward M. Kliment, Western Union, 1505 Chamber of Commerce Bldg., Pittsburgh, Pa. Sec.—H. W. Shepard, Jr., 625 Stanwix St., Pittsburgh.

ROCKY MOUNTAIN: Pres.—Col. Howard S. Gee, Hqs. ADC, Ent AFB, Colo. Sec.—Lt. Col. Michael E. Wardell, Hqs NORAD, Ent AFB, Colo.

ROME-UTICA: Pres.—Murray Socolof, 811 Bradford Drive, Rome, N. Y. Sec.—Robert F. Weil, The Paul Revere, Turin Road, Rome, N. Y.

SACRAMENTO: Sec.—Capt. Robert McMorrow, 951 La Sierra Drive.

SAN DIEGO: Pres.—Cmdr. Samuel Freedman, Chemalloy Electronics Corp., Gillespie Airport, Santee, Calif.

SAN FRANCISCO: Pres.—J. T. Chatterton, Mackay Radio & Tel. Co., 350 Mission St., San Francisco, Cal. Sec.—Carroll V. N. Steffen, Pacific T&T Co., 74 New Montgomery St., S. F.

SAN JUAN: Pres.—Cdr. Harry C. Rodin, USN, 10th Naval District, U. S. Naval Sta., San Juan, P. R. Sec.—Albert R. Crumley, Crumley Radio Corp., Box 10073, Caparra Heights, San Juan, P. R.

SANTA BARBARA: Pres.—RAdm. Clarence C. Ray, 63 Manzanita Lane, Star Route, Santa Barbara, Cal. Sec.—Walter W. Montgomery, Raytheon Co., P. O. Box 636, Santa Barbara.

SCOTT-ST. LOUIS: Pres.—Col. George A. Zahn, Hq. AACS, DCS/COMM, Scott AFB, Ill. Sec.—Allan L. Eisenmayer, P.O. Box 456, Trenton, Ill.

SEATTLE: Pres.—Cdr. Leo J. Larkin, Naval Communications Station Seattle, Seattle 99, Wash. Sec.—J. Alan Duncan, 6836 29th Ave., N. E., Seattle 15, Wash.

SOUTH CAROLINA: Pres.—E. D. Biggerstaff, Jr., Charleston Naval Shipyards, Charleston, S. C. Sec.—Donald D. Harris, Southern Bell T&T Co., Owen Bldg., Columbia, S. C.

SOUTH TEXAS: Pres.—Maj. Gen. Harry Reichelderfer, Southwest Research Inst., 8500 Culebra Rd., San Antonio. Sec.—John D. Rainbolt, Southwestern Bell Tel. Co., 301 Broadway, San Antonio.

SOUTHERN CALIFORNIA: Pres.—John W. Inwood, Western Union, 745 So. Flower St., Los Angeles. Sec.—David G. Soergel, North American Aviation, Inc., 9150 E. Imperial Hwy, Downey, Cal.

SOUTHERN CONNECTICUT: Pres.—John N. Higgins, KIP Electronics Corp., 29 Holly Pl., Stamford, Conn. Sec.—J. A. Leopold, Dictaphone Corp., 375 Howard Ave., Bridgeport.

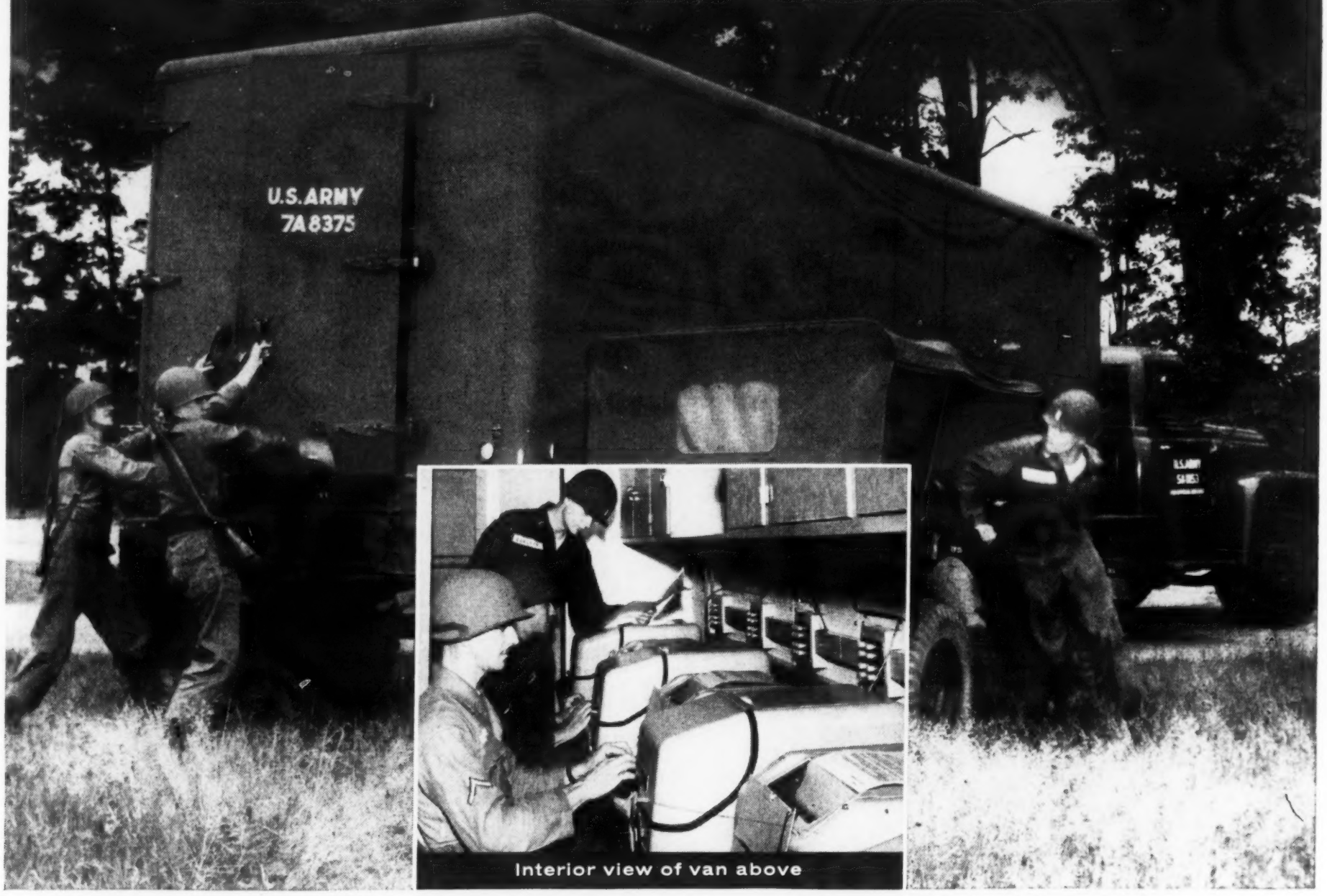
SWITZERLAND: Pres.—Capt. Gerald C. Gross, USNR, Intl. Telecommunications Union, Geneva. Sec.—Robert V. Lindsey, Intl. Telecommunications Union, Geneva.

TINKER-OKLAHOMA CITY: Pres.—Lt. Col. George L. Timme, Jr., GEEIA Rgn., Tinker AFB, Okla. Sec.—Maj. John L. Whyatt, 3rd AACS Sqdn. (Mob), Tinker AFB.

TOKYO: Pres.—Col. Bradford H. Wells, USAF J-6, APO 925, S. F. Sec.—Maj. Robert G. Ramsey, 1956th AACS Sq., APO 925, S. F.

WASHINGTON: Pres.—A. W. Christopher, Sylvania Electric, 734 15th St., N.W., Washington, D. C. Sec.—H. R. Hartsough, AT&T Co., 1001 Connecticut Ave., N.W., Washington, D. C.

NERVE CENTER
for teleprinted messages



Interior view of van above

Kleinschmidt teletypewriters move up with the U. S. Army, operating without interruption under combat conditions

Constant contact, *in print*, between combat headquarters and widely-dispersed field units! Developed in cooperation with the U. S. Army Signal Corps, Kleinschmidt teletypewriters in this mobile communications center are capable of sending and receiving thousands of teleprinted messages a day. Operation is fast, accurate, dependable, simple. In recognition of proved performance, Kleinschmidt equipment for the U. S. Army is manufactured under the Reduced Inspection Quality Assurance Plan. Now Kleinschmidt experience points toward new accomplishments in electronic communications for business and industry. The new concepts, new applications are virtually unlimited.

KLEINSCHMIDT

DIVISION OF SMITH-CORONA MARCHANT INC., DEERFIELD, ILLINOIS

Pioneer in teleprinted communications systems and equipment since 1911

AFCEA Group and Sustaining Members

Communications—Electronics—Photography

Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security.

Sustaining Members

Cook Electric Co. • International Telephone & Telegraph Corp. • New York Telephone Co.

Acme-Danneman Co., Inc.
Adler Electronics, Inc.
Admiral Corp.
Aircraft Radio Corp.
Allied Control Co., Inc.
Allied Radio Corp.
American Cable & Radio Corp.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Amphenol/Borg Electronics Corp.
Anaconda Wire & Cable Co.
Andrew Corp.
Arnold Engineering Co.
Atlas Film Corp.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Autonetics, Division of North American Aviation, Inc.
Barry Controls, Inc.
Beiser Aviation Corp.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Contraves Italiana
Convair, Division of General Dynamics Corp.
William C. Copp & Associates
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
A. C. Cossor Ltd.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Diamond State Telephone Co.
Dictaphone Corp.
DuKane Corp.
Du Mont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Electronic Communications, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
General Analysis Corp.
General Aniline & Film Corp.
General Communication Co.
General Electric Co.
General Electric Co., Defense Systems Dept.
General Telephone & Electronics Corp.
Gilfillan Bros., Co.
Globe Wireless, Ltd.
Gray Manufacturing Co.
Hallamore Electronics Co.
Haller, Raymond and Brown, Inc.
Hallicrafters Co., The
Haloid Xerox Inc.
Hazeltine Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hoffman Laboratories, Inc.
Hogan Laboratories, Inc.
William F. Hogan Associates, Inc.
Hughes Aircraft Co.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
Institute of Radio Engineers
Instruments for Industry, Inc.
International Business Machines
International Resistance Co.
Jacobsen Manufacturing Co.
Jansky & Bailey, Inc.
Jerrold Electronics Corp.
Kellogg Switchboard & Supply Co.
Kleinschmidt Laboratories, Inc.
Leich Sales Corp.
Lenkurt Electric Co.
Lewyt Manufacturing Corp.
Ling-Altec Electronics, Inc.
Litton Industries, Inc.
Lockheed Aircraft Corporation
Machlett Laboratories, Inc.
Magnavox Co.
Marconi's Wireless Telegraph Co. Ltd.
Materiel Telephonique Co.
McCoy Electronics Co.
Michigan Bell Telephone Co.
Montgomery Co., The
Motorola Inc.
Mountain States Telephone & Telegraph Co.
Mullard Ltd.
Muter Co., Rola & Jensen Divisions
National Co., Inc.
Nelson Technical Enterprises, Inc.
Nems-Clarke Co., Div. of Vitro Corp. of America
New England Tel. & Tel. Co.
New Jersey Bell Telephone Co.
North Electric Co.
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co.
O'Keefe & Merritt Co.
Pacific Mercury Television Mfg. Corp.
Pacific Telephone & Telegraph Co.
Packard-Bell Electronics Corp.
Page Communications Engineers, Inc.
Phelps Dodge Copper Products Corp.
Philco Corp.
Photographic Society of America
Plessey Co., Ltd.
Prodelin Inc.
Radiation, Inc.
Radio Corporation of America
Radio Corporation of America, Astro-Electronic Products Div.
Radio Corporation of America, Defense Electronic Products
RCA Great Britain, Ltd.
Radio Engineering Laboratories, Inc.
Radio Frequency Laboratories, Inc.
Ramo-Wooldridge, Division of Thompson Ramo Wooldridge Inc.
Raytheon Co.
Red Bank Division, Bendix Aviation Corp.
Reeves Instrument Corp.
Rocke International Corp.
Saxonburg Ceramics, Inc.
Scanner Corporation of America, Inc.
Servo Corporation of America
Singer Manufacturing Co., The Military Products Division
Smith-Corona Marchant Inc., Research and Development Division
Society of Motion Picture & Television Engineers
SoundScriber Corp., The
Southern Bell Telephone & Telegraph Co.
Southern New England Telephone Co.
Southwestern Bell Telephone Co.
Sperry Gyroscope Co., Division of Sperry Rand Corp.
Sprague Electric Co.
Stackpole Carbon Co.
Standard Telephones & Cables, Ltd.
Stanford Research Institute
Stewart-Warner Corp.
Stoddart Aircraft Radio Co.
Stromberg-Carlson Co., Division of General Dynamics Corp.
Surprenant Mfg. Co.
Sylvania Electric Products, Inc.
Technical Materiel Corp., The
Telectro Industries Corp.
Tele-Dynamics, Inc.
Telephonics Corp.
Teleprinter Corp.
Teletype Corp.
Texas Instruments, Incorporated
Times Facsimile Corp.
T.M.C. (Canada) Ltd.
Trans-Sonics, Inc.
Tung-Sol Electric, Inc.
Union Carbide Corp.
United Telephone Co.
United Transformer Co.
Van Norman Industries, Inc., Electronics Division
Varian Associates
Webcor, Inc., Government Division
West Coast Telephone Co.
Western Electric Co., Inc.
Western Union Telegraph Co.
Westinghouse Electric Corp.
Weston Electrical Instrument Corp.
Wheelock Signals, Inc.
Wilcox Electric Co., Inc.
Willard Storage Battery Div., Electric Storage Battery Co.
Wisconsin Telephone Co.
Wollensak Optical Co.
Zenith Radio Corp.

NEWS ITEMS AND NEW PRODUCTS

The 1959 Missile Handbook contains an alphabetical listing of 180 missiles, facts about 40 leading projects with pictures and facts on 48 special projects in the missile, rocket and space field.

The Handbook also lists 399 contractors, their projects and plant locations.

Published by Aircraft and Missiles Manufacturing in cooperation with Kendall K. Hoyt, Director of the Association of Missile and Rocket Industries, the Handbook is available for $1.50 from AMRI, 1226 National Press Building, Washington 4, D. C.

• • •

An 8500-foot long pattern test range for large radar antennas has been put into operation by the I-T-E Circuit Breaker Co., Philadelphia.

The new range will permit pattern tests on antennas up to 60 feet wide at frequencies through 2000 megacycles. The first reflector to be tested will be I-T-E's 60-foot wide early warning radar antenna, constructed for the eastward extension of the DEW Line. The pattern tests are used to check azimuth and elevation patterns of new antennas and to measure side lobe strength and antenna gain.

The receiving station is a 45-foot high steel structure which rotates on a steel rail. To avoid ground reflections, it is mounted on top of an 80-foot hill. The range uses a 10-watt wide-band ultra-high-frequency transmitter. Antennas are available for the transmitter to cover the entire frequency range now used for radar and communications antennas.

• • •

Scientists at the Westinghouse research laboratories have developed a new method for growing germanium and other semiconductor materials. It is believed the development may make the manufacture of transistor and similar semiconductor devices fully automatic.

The technique of growing germanium crystals as thin, flat continuous strips, or dendrites an eighth wide and a few thousandths of an inch thick, frees the material from complicated processing that would be necessary with the conventionally grown thick, round ingot.

Useful semiconductor devices are made from a dendrite simply by constructing them directly on its surface. Any desired number of devices can be built on a single dendrite to form a long, continuous strip of devices.

The development of working devices from dendrites is part of a "molecular electronics" project Westinghouse is doing for the Air Force Research and Development Command.

Carried through to the development of over-all systems, the molecular electronics concept could reduce drastically the size, weight and power consumption of space-age electronic systems. The concept involves a new understanding of the basic nature and capabilities of materials and an approach on a molecular and atomic scale to the conception, design and development of materials exhibiting these capabilities.

According to a Westinghouse official, molecular electronics seeks to combine several separate electronic functions into a single operating unit that duplicates their over-all electrical behavior. A solid state device must therefore attain an entirely new order of perfection. Conventional ingots of semiconductor materials must go through tedious and complicated manufacturing procedures and are not likely to yield the near-perfect devices required. The crystalline dendrites could make such units possible. Their quality is more uniform because of the way in which they grow and their desirable properties are not jeopardized by long, complex processing into usable form.

• • •

"Multiple-path whistlers" and other such strange radio effects, unaccounted for under present theories, will perhaps be explained by a new concept being checked out by the Explorer VI "paddlewheel" satellite.

A theory concerning the distribution of ionized matter in outer space postulates irregularities of ionization high above the ionosphere—up to several earth radii beyond. Proposed by Stanford University scientist Robert A. Helliwell, the theory suggests that ionization forms shells or banana-shaped concentrations resembling "ducts" out in space.

A specially developed radio receiver possessing extreme sensitivit is being carried in the paddlewhee satellite. Very-low-frequency signal (15.5 kc) from the Navy's Annapoli transmitter are being received in th satellite where telemetering equip ment relays them to the ground. Ob servations at the launching site hav already given a direct measuremen of the approximate height at whic the ionosphere's "D" layer reflect the 15.5 kc radio signals.

This information is of great im portance to the development of very low-frequency communication, an consequently to radio communicatio with submarines. The low frequen cies can penetrate the ocean to greate depths than can the higher frequen cies.

The shell, or banana-shaped ducts are supposedly aligned with th earth's magnetic field. Their con centrated ionization may be only 1 to 20 percent stronger than the sur rounding ionization, but still ade quate to form a kind of channel tha conducts radio signals with grea efficiency.

Dr. Helliwell is hopeful that th dimensions of the ducts can be de termined, as well as their possibl relationship to irregularities of th ionosphere. It is believed that th upper atmosphere irregularities, like those in the ionosphere are related t the mysterious solar upheavals whic cause magnetic storms and upse radio communications.

• • •

At the 51st annual Conference o Governors in San Juan, Puerto Rico the Governors overwhelmingly backed Governor Rockefeller's recommenda tion to encourage a massive civil defense program.

It is evident that effective public action to protect human life is with out question good insurance against nuclear attack or nuclear blackmail.

Allen W. Dulles, director of the Central Intelligence Agency in a closed session before the Governors said, "If due either to any weakening of our defenses—and all forms of protection against nuclear attack are important elements of our defense—or due to any failure to maintain our retaliatory striking power, we render ourselves susceptible to nuclear black mail, the security of this country and

Teletypewriter Switching Center at Davis, California

AE has developed the switching techniques and control devices that automatically route messages to the proper commands, give instant priority to emergency traffic.

Messages arrive at Teletypewriter Switching Centers on coded tape. The codings indicate whether messages have a single or multiple destination, where they are to go, and the degree of their priority. AE automatic switching systems do the rest.

Switching such as this is AE's business. If you have a tough project in communications or control, AE is ready to take it on. Just write the Manager, Government Service Division, Automatic Electric Sales Corp., Northlake, Illinois.

AE CAN DO

AUTOMATIC ELECTRIC MAKING IDEAS WORK AUTOMATICALLY

Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

of the Free World would be gravely compromised."

Obviously, in a nuclear attack, the enemy would attempt to knock out our retaliatory power; our air and missile bases will be primary targets. There is no guarantee that they will not try to destroy our cities. No one can be sure now how far the enemy will go. However, even if an enemy confines his attack to our retaliatory bases and a few major cities, the radioactive fall-out from his nuclear bombs would threaten life in the entire country. An atomic burst on the ground sends up a mushroom cloud from which radioactive dust will fall hundreds of miles away. Fallout from one test explosion spread over 7,000 square miles of the Pacific Ocean.

A shelter policy based on the knowledge that most of those beyond the range of blast and heat will survive if they have adequate protection from fallout. has been prepared by the Federal Government. The policy, published in book form, includes building plans for five basic fallout shelters. One of the five—the Basement Concrete Block Shelter—has been designed specifically as a do-it-yourself project.

Copies of the booklet may be obtained without charge by writing to the Industry Office, Office of Civil and Defense Mobilization, Battle Creek, Michigan.

• • •

A portable, fully transistorized computer with built-in floating point arithmetic, automatic decimal conversion and single command structure for programming is expected to speed up computation necessary to determine results of U.S. Army field exercises.

The Recomp digital computer, developed by the Autonetics Division of North American Aviation, Inc., Downey, Calif., was selected by a panel of judges for special exhibit at the recently held Wescon Show in San Francisco.

The Stanford Research Institute plans to use the computer in its work with the Army's Combat Development Experimentation Center at Ft. Ord, Calif. The Institute has developed a method of utilizing Recomp to speed computation of the effects of simulated artillery neutralization fire as applied to field exercises. Since the computer is portable it can be taken into the field and placed in operation at the site of experimentation. Data pertinent to the problem are placed in the memory disk prior to and during the actual running of the problem with computational results available in a matter of minutes.

Data inputs are by photoelectric tape reader, control console decimal keyboard and electric typewriter. Information from the computer is received either in punched paper tape form, electric typewriter or by direct digital readout.

• • •

A miniature television camera, weighing 3½ pounds and measuring 2½ inches wide, $3\frac{13}{16}$ inches high and $8\frac{13}{16}$ inches long, is capable of horizontal resolution in excess of 600 lines. The Mark II television camera provides a high definition picture for reading printed matter or data, dials, or recorders used in process monitoring.

The camera is a development of the Vicon Corp., San Carlos, Calif. The company reports the Mark II is specially adaptable to small enclosures or unobserved installations for use in laboratories, wind tunnels, data transmission, and remote viewing of hazardous locations, such as high radiation areas.

The camera equipment includes a single lens mount with optional provision for a manually operated turret or remotely operated zoom lens. Optional accessories include remote pan and tilt mount and enclosures for explosive atmospheres, outdoor installation or high altitude environments.

• • •

The 1959-60 Directory of Professional Photography, published by the Professional Photographers of America, Inc., (PP of A) lists more than 6000 U.S. and foreign professional photographers, their addresses and qualifications.

The use of a code to classify individual qualifications aids in selecting photographers for specific assignments. More than forty classifications of photographic specialization are designated following the names of photographers whose print samples, submitted to a PP of A jury, qualify them for assignments.

Advertising agency personnel and professional photography buyers may obtain directories without charge by writing to Professional Photographers of America, Inc., 152 W. Wisconsin Ave., Milwaukee 3, Wisc. Others wishing copies must send a $5.00 check with their requests.

• • •

An automatic underwater camera designed to probe the unseen ocean bottom to depths of six miles has been developed by Edgerton, Germeshausen and Grier, Inc. of Boston.

The new camera, which is 22 inches long, 5 inches in diameter and weighs about 50 pounds, is housed in a tempered steel casing to withstand pressures of eight tons per square inch and can take up to 500 photographs at 10-second intervals on 35 mm film. A data recording compartment has been built into the camera to record time and other information with each exposure directly on the film. An electrically controlled shutter is synchronized to an electronic flash of 100 watt seconds capacity.

• • •

The Telectro Professional 938 magnetic tape recorder is available at present as a console, a portable field unit, or a rack mounted instrument.

Developed by the Telectro Industries Corp., Long Island City, N. Y., the recorder has a signal-to-noise ratio of over 55 db at both 7½ and 15 i.p.s. tape speed.

Micro-wave Radio

TELECOMMUNICATIONS ENGINEER

Major eastern railroad now actively engaged in every area of communications is seeking experienced communications engineer who desires:

- **Practical application of his training and experience in an essential industry.**
- **Good salary and benefits with definite growth potential leading to management position.**

Candidate should have 3 to 5 years experience in communications field.

Send confidential resume to

MR. R. R. HICKS

Director of Personnel Services

N. Y. CENTRAL SYSTEM

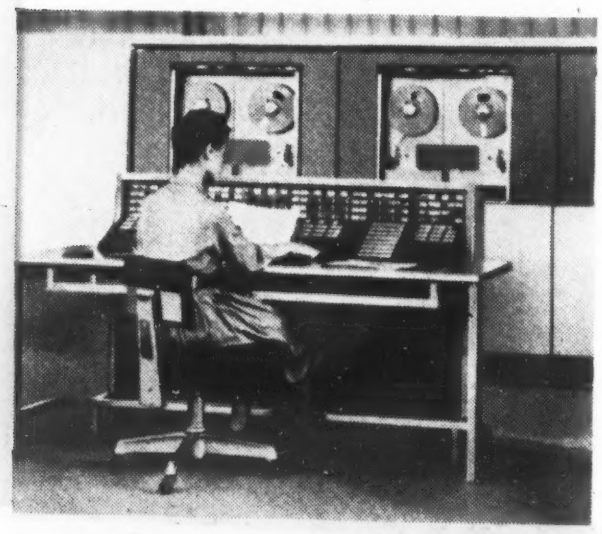
New York 17, N. Y.

ANOTHER WAY RCA
SERVES BUSINESS
THROUGH
ELECTRONICS

RCA Electronics creates the "501" to streamline the paper work of business—it reads, writes, figures and remembers on tape

Much of today's traffic jam in paper work is being eliminated by electronic data processing. But to build a system that would be practical and economical for even medium-sized organizations was a job for electronic specialists.

To solve the problem, RCA drew on its broad experience in building computers for military applications and combed its many laboratories for the latest electronic advances that could help. The result was the RCA "501" high-speed electronic data processing system—the most compact, flexible, and economical ever built. It is a pioneer system with all-transistor construction for business use.



The "501" cuts out paper work bottlenecks for many government agencies and businesses, from stock brokerage firms to public utilities, banks, insurance companies, and steel mills.

It "remembers" millions of letters, numbers, and symbols that are "read" onto its magnetic tapes by such things as punch cards and paper tapes. In a fraction of a second, it can do thousands of calculating, sorting, and comparing operations—and checks each step. Finally, it writes such things as bills, reports, payrolls in plain English at 72,000 characters per minute.

This economical and practical answer to an acute business problem is another way RCA Electronics is helping to simplify the growing complexity of business.

RADIO CORPORATION OF AMERICA

Described as having rapid control response, the recorder starting time is less than 0.1 second. When stopping, the tape at 16 i.p.s. moves less than 2 inches after the stop switch is operated.

• • •

Anti-submarine warfare training is expected to be speeded up by means of a new device that simulates submarines electronically.

Produced by Raytheon Co., Waltham, Mass., the sonar trainer makes training possible at sea without scheduling other submarines to act as targets. Its synthetic target, indistinguishable from real "echoes," may be cleared from sonar scopes immediately should a second target appear.

The trainer's electronic brain fakes all real maneuvers including dives, varying courses, speed changes and torpedo attacks.

• • •

A thermoplastic resin, Marlex rigid polyethylene, is expected to find a wide variety of new uses in the radar and electronics field, according to its developer, the Phillips Chemical Company, Bartlesville, Okla.

The resin is described as a high density polyethylene which can withstand temperatures from —180°F to +250°F and as having low electrical loss properties.

The Company reports the resin's low loss tangent or dissipation factor, together with its low dielectric constant, provides a dielectric medium that is transparent to the microwave energy used in radar search beams and homing or radar tracking systems. The material serves as a structural member for protection for all-weather operation of radar as well as a "window" to the microwave energy.

• • •

A specification sheet describing a newly developed 60 to 800 cycle power converting system which includes a motor-generator set with all necessary controls for the unit, is available from the Kato Engineering Co., Mankato, Minnesota.

The system supplies power for numerous 800 cycle applications including high frequency lighting and intricate electronic control systems. The higher frequency permits the use of smaller electronic components, such as motors, starters, filters and chokes.

The 60 cycle synduction drive motor retains precise speed regardless of load changes on the alternator. The 800 cycle generator is rated at 5 KVA, 120/208 volt, 3 phase, 4 wire and is of the revolving field type.

• • •

Astronauts will be able to look homeward as they depart into space by means of a periscope system which will also serve as a navigational aid. Designed for the National Aeronautics and Space Administration's Project Mercury space capsule the system will enable the space man to view the earth below him on an 8-inch diameter viewing screen and make measurements of his altitude, direction and position in space.

If the automatic re-entry control system should malfunction, the periscope can be used to determine earth position and proper capsule attitude position for firing the retrograde rockets which make re-entry possible.

The system, designed and built by the Perkin-Elmer Corp. of Norwalk, Conn., measures the capsule's altitude by means of an optical altimeter. A manual knob moves 4 indices on the viewing screen which measure the apparent diameter of the earth circle displayed on it, then a calibrated dial reads out the altitude. The standard aircraft type altimeter usually operates on the principal of barometric pressure and would be of small value in space where there is little or no atmosphere.

Another index, also manually operated, measures the angle that the rising or setting sun or moon makes with the longitudinal axis of the capsule. This is for navigational purposes.

• • •

"**In-reactor creep monitor**" is a new device for measuring the growth of metals inside atomic reactors by remote control.

Packard-Bell Electronics Corp., through its affiliate, Technical Industries Corp., of Pasadena, Calif., announced delivery of the monitor which was built for the Hanford, (Wash.) Atomic Works of General Electric. The device reaches into a reactor, measures the creep or growth of materials used in the atomic reactors and reports the results to a safe and distant location.

A company official reports the objective of this and most other atomic instrumentation research is the more efficient design of reactors which will result in lower-cost generation of electrical power.

• • •

Miniature glass wafer capacitor have capacitance from 1 to 10,00 mmfd at 300 volts and will operat at temperatures from —55 to 12 degrees C at full voltage rating.

The wafer capacitors were devel oped by the Corning Glass Works Corning, N. Y., and are designed fo operation in lumped constant dela lines, potted assemblies and minia turized modular circuits.

Designated W-1 through W-5, th new units range in size from a maxi mum of .281 inches in length an .218 inches in width for the W-5 t a maximum of .531 inches in lengt and .812 inches in width for the W-1 Thickness is .060 to .090 inches.

• • •

A series of Infrared Technical Data sheets has been issued by Infrared Industries, Inc. and its division, In frared Standards Laboratory. A com prehensive effort has been made t provide complete information abou infrared photoconductors and instru mentation.

The literature is described by the company as a "must" for design, test and production engineers and others seeking a better understanding of or contemplating use of infrared techniques.

The data sheets are available upon request by writing to Infrared Industries, Inc., P.O. Box 42, Waltham 54, Mass.

• • •

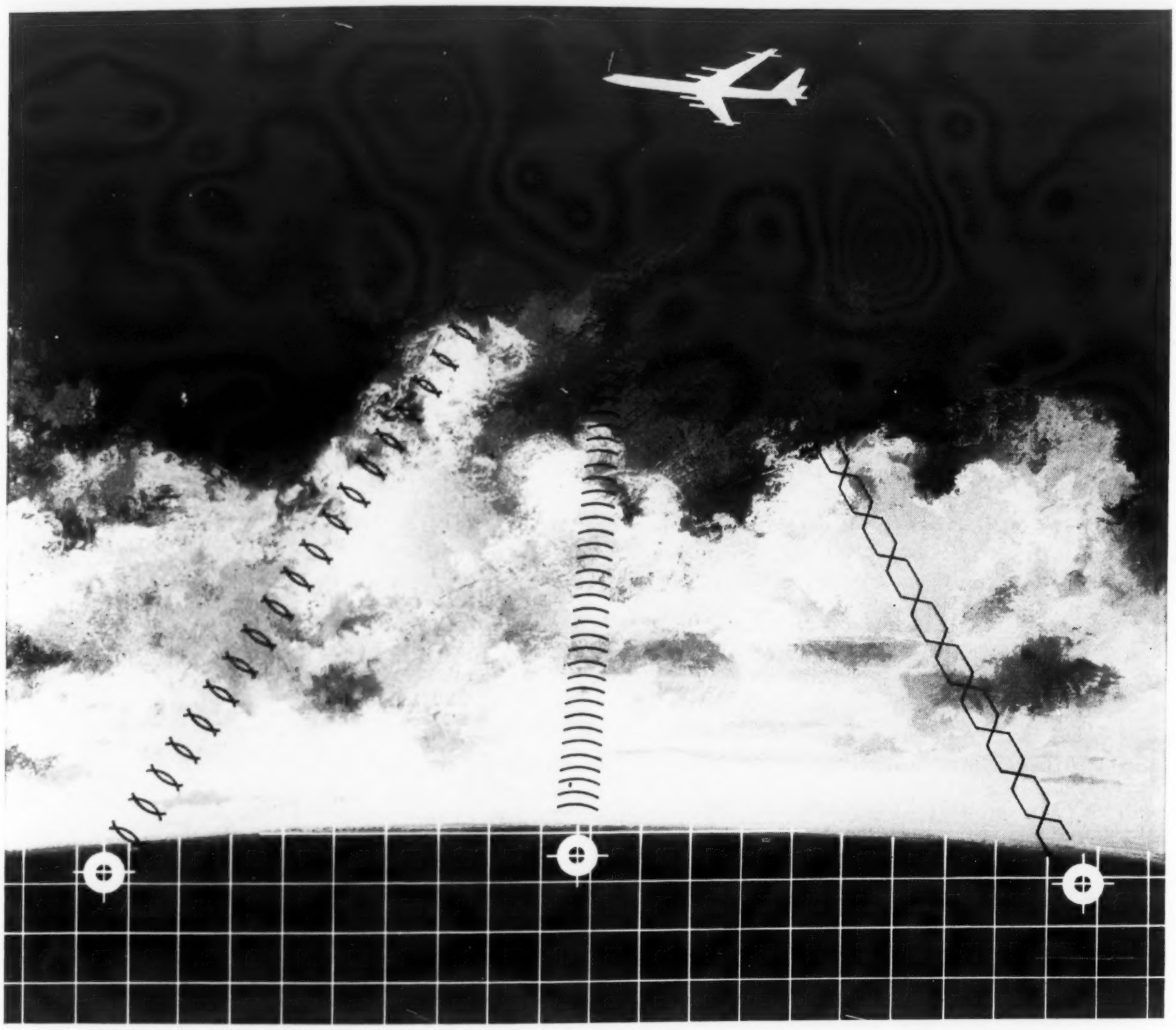
A new direct-reading gaussmeter, designed to measure direction and magnitude of flux density, has been developed by F. W. Bell, Inc., Columbus, Ohio. The instrument can also plot flux paths and measure flux leakage.

Operating on the Hall Effect, the gaussmeter uses a thin wafer of indium arsenide with a temperature coefficient of 0.1% as its sensing element. The smallness of the element (.019 inches thick and .125 inches wide) permits insertion of the flat probe tip into narrow air gaps.

The instrument will read DC flux in the presence of a strong AC field, rejecting the AC field and giving readings as long as the probe is held in a constant magnetic field.

The unit weighs five pounds and has a built-in 4½-volt battery as a power supply.

SYLVANIA ELECTRONIC SYSTEMS . . . **IN RECONNAISSANCE**



. . . advanced systems for advance intelligence

As THE WORLD'S CAPABILITIES for electronic warfare expand, early warning and countermeasure systems depend more and more on advance intelligence. Electronic reconnaissance is the new watchword of the day.

Such systems, if they are to keep pace with offensive measures, demand the utmost in technical research, development and production capacities.

Sylvania has long occupied a leading position in supplying airborne and ground-based passive reconnaissance systems and subsystems to the Armed Forces. A very large part of Sylvania's research and development program is engaged in this work.

Sylvania assumes full responsibility in such advanced projects . . . from system analysis, through research, engineering, production . . . and on into field engineering, training of operating personnel, as well as supervision and maintenance. A Sylvania Systems representative will be happy to discuss these capabilities with you.

Sylvania Electronics Systems
A Division of Sylvania Electric Products Inc.
63 Second Avenue, Waltham, Mass.

SYLVANIA GENERAL SYSTEM
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

The First U. S. Army Military Affiliate Radio System (MARS) Technical Net will resume operations in November. The net operates on single sideband (upper sideband) on 4030 kc. each Wednesday evening at 9:00 P.M. Eastern Daylight Time.

The net has been operating since the beginning of 1958, during which time it has presented talks and forums by leading scientists and engineers, and is under the jurisdiction of Capt. Joseph Fischler, MARS Director, and Col. Wm. Jennings, Chief Signal Officer, First Army.

The schedule for November is:

Nov. 4: "SSB Exciter Circuits for a New Beam Deflection Tube," by Harold Vance, K2FF, Manager Sales Engineering, Distributor Products, RCA Electron Tube Div.

Nov. 11: "Modern Communications Receiver Circuitry," by Byron Goodman, W1DX, Assist. Tech. Editor, American Radio Relay League.

Nov. 18: "Tubes vs. Transistors in RF Circuits," by Kenneth Redmond, Applications Engineer, Amperex Corp.

Nov. 25: "Transistorized Gadgets and Gimmicks," by Robert Gunderson, W2J10, Editor, Braille Technical Press.

• • •

A new communications-electronics journal has been published recently by the USAF. The magazine is primarily a medium to inform and educate communications and electronics personnel of the USAF on matters pertaining to the USAF communications and electronics mission.

The pilot edition of *The USAF Communications-Electronics Journal*, published this past July, contains articles on Project Quick Fix (one phase of the complete modernization of the AIRCOM system), and on the search for signal isolation. Also included are news from the commands, recommended publications and reading for CE personnel, and a report on research and development in industry and laboratory.

Inquiries concerning the journal may be directed to Communications-Electronics Doctrinal Project Office, Air University, Maxwell AFB, Alabama.

• • •

Transwitch, a new "memory" element, is expected to find application in the computer field.

Essentially a latching device, the Transwitch, when turned on, stays on after the turn-on signal has been removed. Similarly, when turned off, Transwitch stays off after the turn-off signal has been removed. The unit is capable of "remembering" the last signal instruction given without the destructive read-out problem associated with magnetic memory elements.

According to Transitron Electronic Corporation, Wakefield, Mass., developers of the unit, the device eliminates the need for the two transistor "flip-flop" design, thus reducing size and number of components.

• • •

An all-digital communication and switching system automatically bypasses battle-damaged lines and reroutes messages over the fastest available path.

The new system, designed by International Telephone and Telegraph Laboratories, Nutley, N. J., in cooperation with the U. S. Army Signal Research and Development Laboratory, Ft. Monmouth, N. J., was conceived to complement military strategy calling for Pentomic army divisions to fight widely dispersed battles in which speed, maneuverability, and reliable communications will be decisive factors.

The Digital Communication System, (DIGICOM) handles information from computers, radar, analog signals, teleprinters, tape-readers, voice and telemetering systems.

Each unit is completely transistorized and operates on less than 30 watts of power. It can operate from a light trailer that could be jeep-mounted for complete mobility. When placed at points on the connecting main circuits or trunk lines, DIGICOM acts as an electronic switchboard, automatically seeking out the fastest message path from originating point to destination. Should one or several trunks become inoperative, the system simply by-passes the damaged section and re-routes the message, using another trunk in its system. Possible message paths are increased proportionately as more main trunks are fed into the overall system. By transmitting speech signals in the form of electrical pulses which are reconverted into audible messages at their destination, DIGICOM makes telephone messages virtually immune to interference.

Local service cables fan out from each DIGICOM switching facility, furnishing communication links to field units. Each unit handles four local loops, with up to 24 telephones connected into the system by each o the four lines. The basic switchin system is not limited to a specifi number of channels; 600 or mor can be easily added with suitable de sign modifications, the compan states.

• • •

An airborne recorder, one of th smallest instrumentation recorder developed for complete data acquisi tion, displaces only 1.6 cubic feet o space but offers from 7 to 32 record ing tracks of data, depending upo the recording technique selected Miniaturization is attained by th compact arrangement of electronics use of an all-transistor, solid-stat system and the use of light-weigh metals in the construction of the chassis.

Designated the AR-200, the air borne recorder was developed by the Ampex Corp., Redwood City, Calif. and was one of the 18 electronic in struments from a field of 140 entries to be selected for special exhibit by the judges of the Wescon Show in San Francisco.

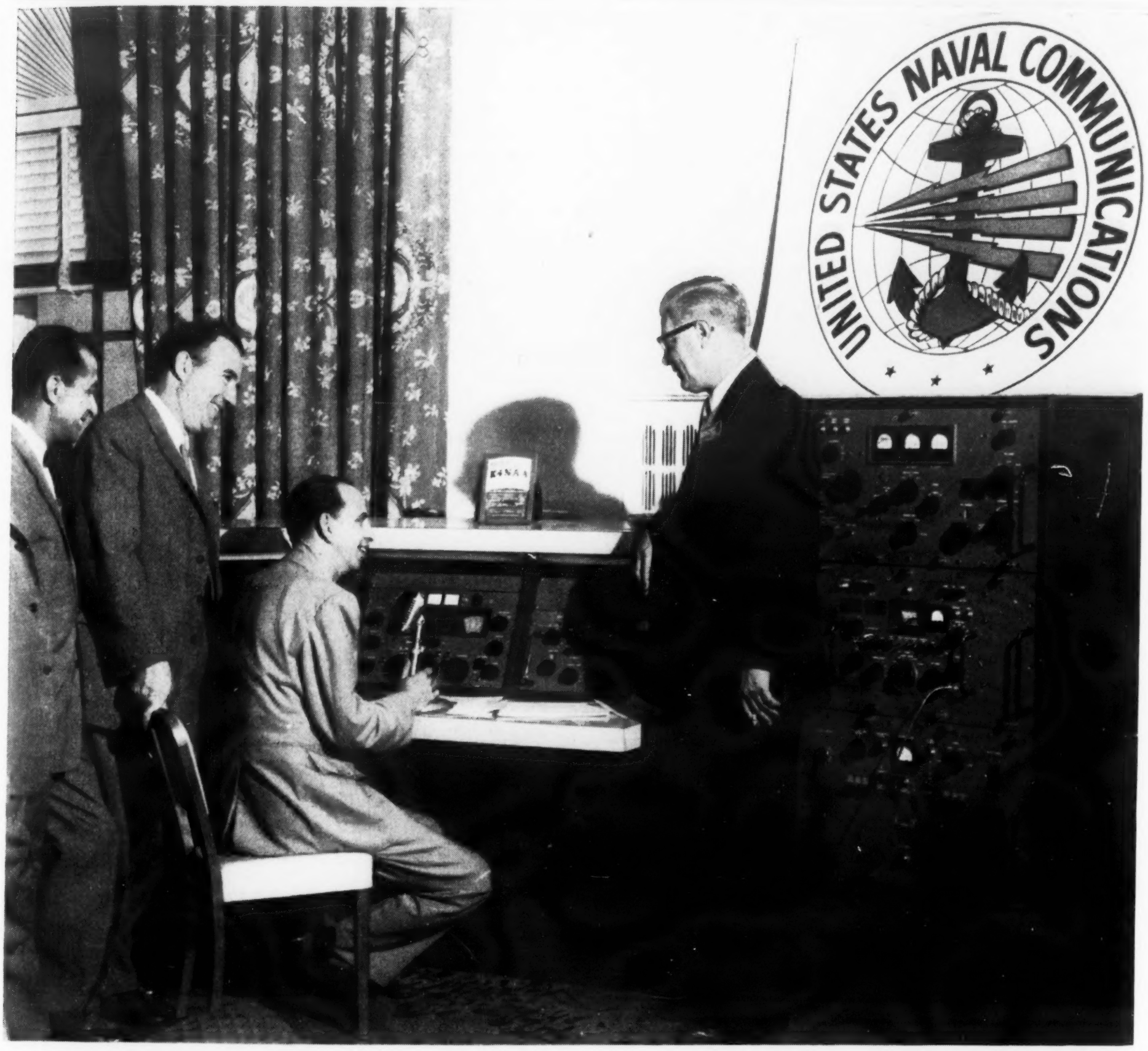
It operates at altitudes up to 100,000 feet and can function in 95% humidity. According to Ampex, the unit operates on 28-volt DC available in most aircraft, and requires only 150 watts for operation. It can withstand shocks up to 15 times the force of gravity.

• • •

A new standards publication approved by the National Electrical Manufacturers Association (NEMA) offers a wide variety of information of practical value to both manufacturers and users of gas turbines.

Designated as *Gas Turbine Power Plants*, SM 30-1959, the publication was developed by NEMA's Gas Turbine Group and represents the results of two years work by top engineers from all domestic producers of this comparative newcomer to the prime mover field. Major portions cover the following key subjects: definitions, nomenclature, ratings and performance, accessories, shipment and installation, and weather protection. The rating and performance chapter features the industry's "state of the art" thinking on such topics as normal operating conditions, pressure drop information, necessary operating data, factors affecting performance, and fuels and their high heat and low heat values.

Copies of the standard may be obtained for $1.00 per copy from NEMA Headquarters, 155 East 44th Street, New York 17, N. Y.



ONE OF THE HIGHLIGHTS OF THE AFCEA CONVENTION

(WASHINGTON, D. C., JUNE 3-5)

...was the operation of K4NAA/3 from the lobby of the Sheraton Park Hotel. Several hundred contacts were made using the TMC GPT-750 and a three element rotary. The first contact was with Commander Lee Denning, W4ESH, of the Bureau of Ships. Among the notable visitors were George Bailey, W2KH, of the ARRL and Ray Meyers, W6MLZ, of K6USA fame. At the mike is Chief Christopher Walker Jr., W4SSN (EX VP9CZ). Looking on from left to right are Frank Merrill, W4JFE, Hank Geist, W1AOH and Bill Deans, W2AZA.

The TECHNICAL MATERIEL CORPORATION

IN CANADA
TMC Canada Ltd., Ottowa, Ontario

Main Office: MAMARONECK
NEW YORK

An electrical engineering professor, Pierre M. Honnell of Washington University, St. Louis, and his doctoral students have developed the first matric calculus computer to work with both general matric equations and with differential and integral calculus equations.

Matric calculus methods previously were used chiefly in mathematical research. With increasing frequency the matric methods are now being applied to scientific problems in physics, dynamics, electrical networks and econometrics.

Digital computers use the fundamental mathematical concepts of adding and subtracting almost exclusively in their operation, while matric equation analyzers work with entire equation systems.

The theory behind Dr. Honnell's computer is based on the synthesis of electronic active networks on an admittance basis. The basis is such that each matric entry of the mathematical equation being solved is represented by one physical component in the synthesis network. A complete homeomorphism or 1-to-1 correspondence exists, which theoretically can be made as exact as desired, between physical network components and mathematical matric entries.

Through expanded research, Dr. Honnell and his co-workers hope to determine the ultimate potential of the new computer in matric calculus problems such as linear transformation and matric products.

• • •

The Bat was the first operational homing missile used successfully in combat by any nation. The air-to-surface guided missile saw action against ship targets well over a decade ago during the last months of war in the Pacific.

Unlike the more widely known German V-1 and V-2 rockets, the Bat could guide itself to its target by means of target echoes of pulsed microwave radiation emitted by the missile. Just as a real bat can guide itself through a dark cave by the echoes of the sounds it emits, the Bat's radar guidance system could "see" its target under any condition of visibility.

The Bat radar was an AN/DPN-1, a pulse-type, with a magnetron transmitter and a superheterodyne receiver. Directional information concerning target elevation and azimuth was obtained through a conical scanning device with a paraboloidal antenna. The autopilot used feedback amplifiers, gyroscopes, and electrically driven servos to control the missile through "elevons" on the wings.

The Bat was one of three missiles developed for the Navy's Bureau of Ordnance by a missile development activity initiated in 1940 at the National Bureau of Standards. Its development and use were among the most closely guarded secrets of the war; not until five months after the end of the war did the Navy Department release information on the Bat to the press.

• • •

Aviation's first universal system for automatic flight control has been developed by the Sperry-Phoenix Co. of The Sperry Rand Corp., and the U.S. Army Signal Corps.

The new system operates automatically to control any type of U.S. Army aircraft — helicopters, fixed-wing planes or high-performance pilotless drones.

Essentially a combination of universal type electronic "building blocks," the system can be installed in various combinations in order to achieve any desired degree of automation in flight.

Flight control systems have been traditionally custom-engineered for each type of aircraft, or at least extensively modified to fit design requirements of individual aircraft.

• • •

A new sub-miniature rate gyro embodying eddy current damping, is described as capable of withstanding a range of temperature ambients from —65°F to 400°F. The gyro is a single degree of freedom instrument with an over-all diameter of ¾ inches. The rotor is powered by a 3-phase hysteresis motor.

Produced by Whittaker Gyro Division of Telecomputing Corp., Van Nuys, Calif., the gyro was designed for use in missiles, drones, radar antennas, or anywhere that weight and size are critical factors.

Names in the News

Dr. Edward L. Ginzton has been elected Chairman of the Board of Varian Associates. One of the founders of the company, Dr. Ginztson served as a member of the Board of Directors and was assistant to the late Chairman of the Board, Dr. Russell H. Varian. **Emmett Cameron** has been promoted to Executive Vice President and General Manager and will be assigned complete operating authority for the company's Palo Alto operations.

Dr. Hans K. Ziegler has been named chief scientist at the U. S. Army Signal Research and Development Laboratory, Ft. Monmouth, N. J. Dr. Ziegler was Director of the Laboratory's Astro-Electronics Division.

S. Edwin Piller, Director of the First U. S. Army MARS SSB Technical Net, was appointed group supervisor of the SSB Section of the Eldico Electronics Division of Radio Engineering Laboratories.

Brigadier General John C. Monahan has been appointed Chief of the Research and Development Division, Office of the Chief Signal Officer. General Monahan previously served as Deputy Chief, U. S. Army Security Agency.

Charles P. Johnson has been named Military Sales Manager of Kellogg Switchboard and Supply Company and will direct activities of the military sales force. Prior to his promotion, he was SAGE Program Manager.

Dale Samuelson has been named head of a new Marketing Department of Wilcox Electric Company. He will direct the sale of electronic equipment to military agencies.

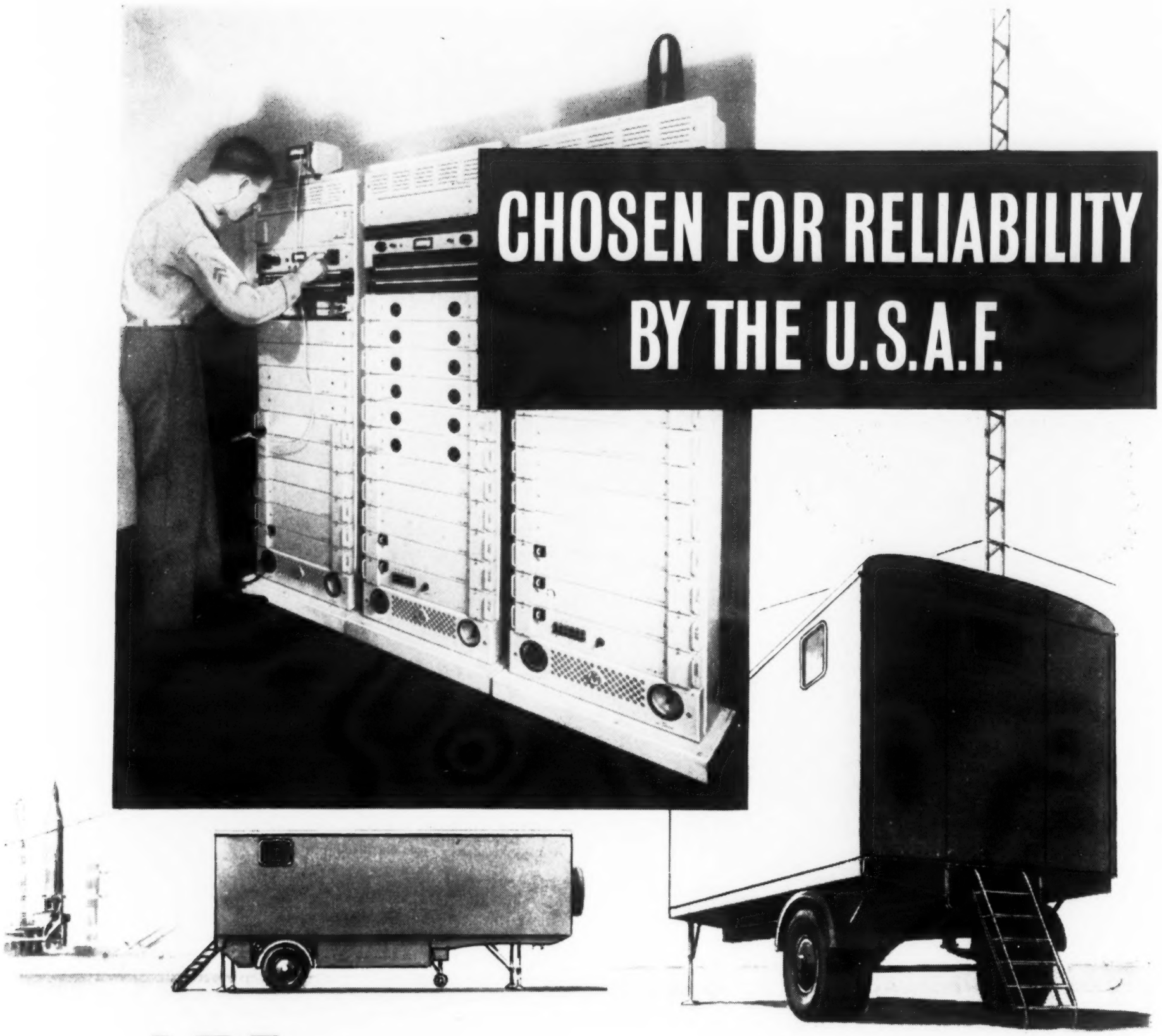
Dr. Ernst A. Steinhoff has been selected Director of the newly-formed Missile Department of Crosley Division, Avco Corporation. Dr. Steinhoff previously was Deputy Technical Director in charge of Defense Products for the Aerophysics Development Corporation.

Dr. Walter R. G. Baker, President, Syracuse University Research Corporation, received the David Sarnoff Gold Medal Award recently for meritorious achievement in television engineering.

Forrest W. Donkin, former Vice President of Operations, western division, Page Communications Engineers, Inc., has been elevated to senior Vice President. He will supervise corporate plans, sales and customer relations, finance and office services. **Charles Singer**, Vice President of Operations, eastern division, has become Vice President and Director of the maintenance and operations department.

Colonel Murray A. Little has been named Director of the Armed Services Electro-Standards Agency, Ft. Monmouth, N. J. Colonel Little will seek the aid of industry in the development of a more effective standardization program.

Horace L. Woodward, a former patent attorney in the Legal Division, Patent Bureau, Office of the Chief Signal Officer, died recently.



CHOSEN FOR RELIABILITY BY THE U.S.A.F.

A.T.E. VEHICLE MOUNTED TELEPHONE AND TELEGRAPH CHANNELLING EQUIPMENT FOR MOBILE RADIO SYSTEM TERMINALS

The adaptability, flexibility and high quality of A.T.E. carrier telephone/telegraph channelling equipment has once again been demonstrated by its application to a vital U.S.A.F. defence requirement.

Compactly mounted with associated Marconi radio equipment in suitable vehicles, it forms a major part of the equipment of a large number of strategic mobile signal units.

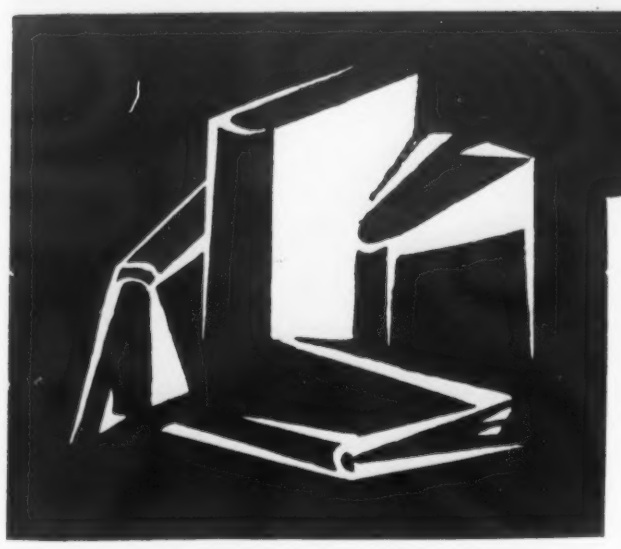
Meets stringent U.S.A.F. specification.
Provides dependable high grade circuits.
Can be used with line or cable networks as well as radio links.
Readily adaptable to large or small system requirements.
Full signalling facilities, dialling, 300-3400 c/s speech band.

AS SHOWN AT THE ARMED FORCES COMMUNICATIONS AND ELECTRONICS ASSOCIATION EXHIBITION

ATE

AUTOMATIC TELEPHONE AND ELECTRIC CO. LIMITED

STROWGER HOUSE · ARUNDEL STREET · LONDON · ENGLAND



Books

FIRST COLLOQUIUM ON THE LAW OF OUTER SPACE. THE HAGUE 1958. PROCEEDINGS, edited by Andrew G. Haley and Welf Heinrich Prince of Hanover. Springer-Verlag in Wien, Austria, 1959, 126 pages, $4.50.

The idea of an International Astronautical Federation Colloquium on Space Law was conceived by the editors during the course of a lecture tour of American universities in 1957 on *The Law of Outer Space.*

The lecture tours made apparent the widespread interest existing on the subject of the law of outer space. Also aware there was no international effort in operation devoted to this subject, the editors decided to call the First Colloquium on Space Law.

In this publication, the reader is presented with the many excellent papers that were presented before the Colloquium. The volume will undoubtedly be met with as much enthusiasm as were the lectures of the editors at our universities just two years ago.

LOGISTICS IN THE NATIONAL DEFENSE, by Rear Adm. Henry E. Eccles, USN, Retired. The Stackpole Company, Harrisburg, Pa., 1959. 347 pages, $5.00.

Three main themes are stressed in this book: the nature of modern war as a spectrum of human conflict; the relationship existing between strategy and logistics, and the position of logistics as the bridge between the national economy and the actual operation of combat forces. Underlying these themes is the basic idea that, unless the growth factors are positively recognized and controlled, logistic support tends to "snowball" out of all proportion to the combat power developed.

From these basic concepts, the author shows how logistic factors can be viewed in proper focus from the perspective of high command.

The author discusses fundamental causes and effects as they operate in practical military logistics. Among these are: flexibility and momentum, the problem of priorities and allocations and logistic discipline.

The book is based on exhaustive research and the author's own extensive practical experience. Admiral Eccles has emphasized those features of strategy, logistics, planning, and operations which will endure regardless of future technological progress.

FROM MICROPHONE TO EAR, by Gerard Slot. The MacMillan Co., N. Y., 1959. 258 pages, $4.50.

Almost 500 years ago, printing from movable type was invented. Since that time the majorities of people of succeeding generations have had the opportunity to know the things of value that their ancestors wished to communicate to them.

Less than 100 years ago the invention of sound recording and reproducing devices released the spoken word to mankind. Today, people not only can read the words of great men long since dead, but they also have the opportunity to hear these words, time and again if they so desire. We have been able to catch an auditory glimpse of the superb musical gifts of Caruso and Galli Curci and we will be able to observe the maturing musicianship of Van Cliburn. It will be possible for our descendants to hear sounds of oceanic life existing at depths man himself had not yet penetrated and to hear the first man-made satellites as they pioneered around the Earth.

The development of the devices which make these things possible is traced in a lucid and interesting manner by Mr. Slot. He views the entire process of sound recording and reproduction from microphone to loudspeaker, from the time of Edison's "phonograph" to the stereophonic reproduction of today.

Particularly interesting are the many factors described by the author which ultimately effect the quality of reproduction—factors ranging from the selection of a hall which happens to have the appropriate acoustics for the recording of a Haydn symphony to the specific gravity of the needle used on your record player.

Interesting too, was Mr. Slot's report that the development of radio broadcasting was originally seen as a serious threat to the phonograph industry much as the development of television frightened the movie makers in Hollywood just a few years back.

The book can be recommended not only as a practical one for sound-technicians but also as an entertaining one for record enthusiasts.

ECHOES OF BATS AND MEN, by Donald R. Griffin. Anchor Books, Doubleday & Co., Inc., N. Y., 1959. 156 pages, $.95.

Dr. Griffin, a Professor of Zoology at Harvard University, has long been interested in the physiological mechanisms that operate in the bodies of animals and men. While a student at Harvard, he began his study of bats and recorded the ultrasonic cries with which bats navigate.

Echoes of Bats and Men is a fascinating account of the way such living organisms as bats, beetles and porpoises utilize reflected sound waves to live in their particular environments. By the emission of sound and the perceiving of its echo these highly specialized organisms are able to snare food and avoid physical harm.

Dr. Griffin has advantageously combined the fields of physics and biology in his studies of living mechanisms. He believes that by attaining an understanding of these mechanisms, the horizons of physics will have been extended in the process.

ROAD OF PROPAGANDA: The Semantics of Biased Communication, by Karin Dovring. Philosophical Library, N. Y., 1959. 158 pages, $4.75.

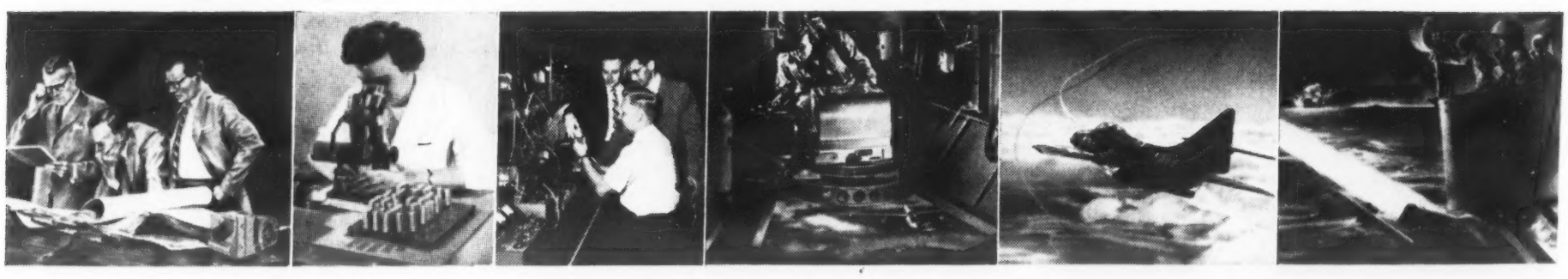
This is a systematic analysis of the uses and abuses of propaganda in mass communications. It offers new perspective on the problems of cross-national and cross-cultural relations —matters which are crucial in our present search for understanding at home and abroad.

Principles of propaganda are described here as a matter of biased communication undertaken by conflicting ideologies and interests. Weapons of this communication are the "emotional languages," which can influence public attitudes and are difficult to analyze and counter with appropriate measures.

The book is of importance for analysts of mass communication, and those who communicate in all media. It also offers good information to the citizen who wants to know how he is being swayed in the battle for his mind.

New horizons in infra-red... by Bulova

Bulova designer-engineers can help you from concept to production



Bulova infra-red, camera, TV and radar techniques are being combined with Bulova analysis and display systems for defense and industry.

Bulova infra-red R & D extends to fire control systems, filters, reticles and thermistor bolometers, as well as advanced work in mosaic and photoconductor cells. Here is a proven capability ready to assist you in any area of IR development from black body emanations through detection to final display.

Experience in precision design and precision manufacture is the Bulova tradition, the Bulova capability. It has been for over 80 years. For more information write—

Industrial & Defense Sales, Bulova, 62-10 Woodside Ave., Woodside 77, N. Y.

BULOVA

Index to SIGNAL

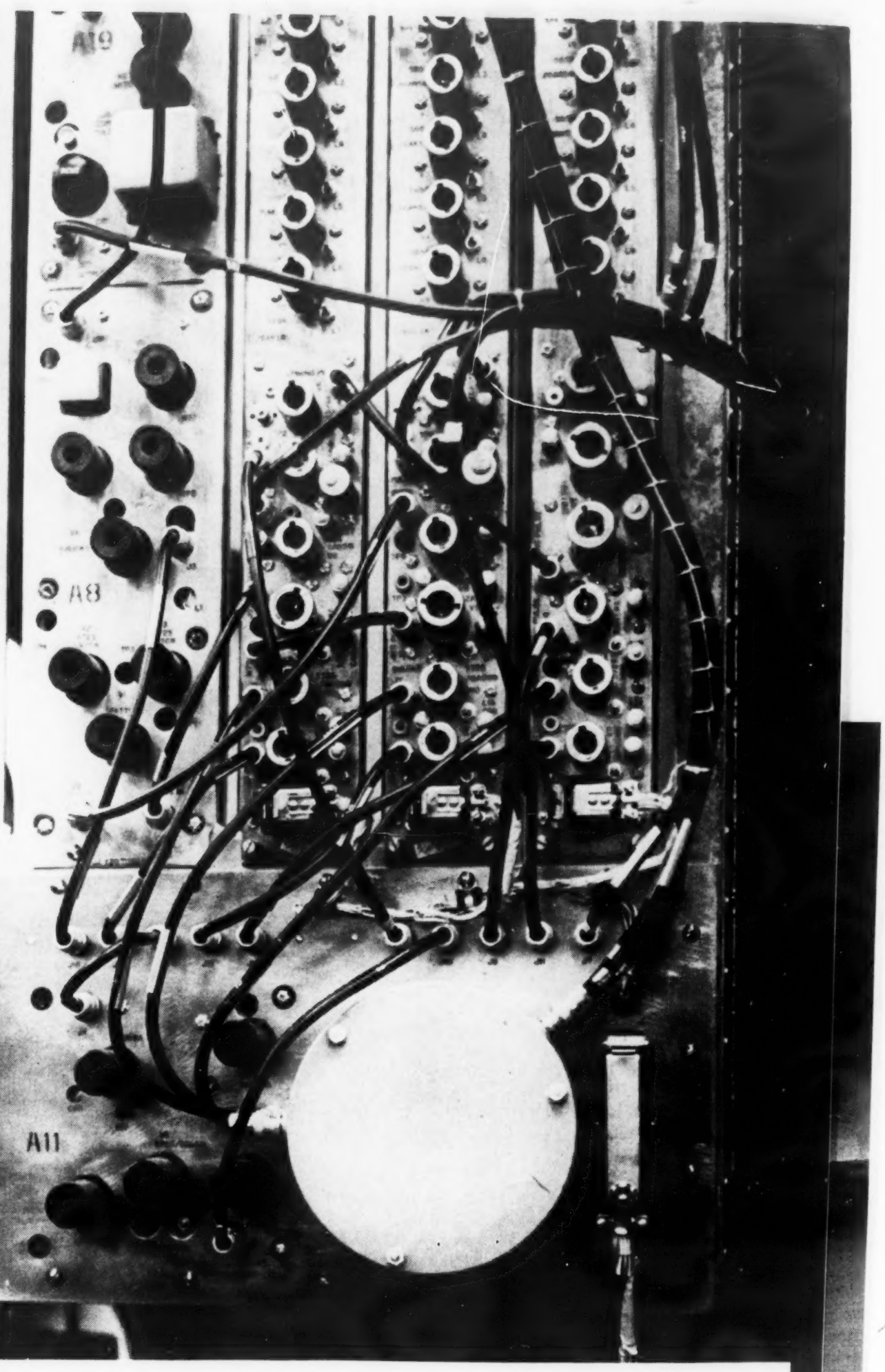
Volume XIII

September 1958 thru August 1959

TITLE INDEX	Issue No.	Page
AFCEA Affairs		
1. Another Nationwide Tribute to AFCEA	12	27
2. 1959 AFCEA National Convention Highlights	12	7
Amateur Radio		
3. Amateur and the Military Affiliate Radio System, The	11	16
4. Amateur Radio in the Services	4	34
5. America's Obsolete Weapon? The Radio Amateur	8	28
6. Little Acorns	8	23
7. Navy and Amateur Radio, The	10	11
8. Radio Amateur, The, — America's Secret Weapon	4	13
9. SIGNAL Gets Around	6	22
Communications Systems		
10. Automatic Communications Switching System, An	1	36
11. Communications and the Commander	3	14
12. Communications in the Arctic	1	40
13. Communications Media for Space Age Systems	3	39
14. Decision and Communication	7	34
15. Frescanar—A 3-Dimensional Radar System with Frequency Scanning	5	16
16. Let's Talk About Communications	8	9
17. Management and Control of Military Communications	8	25
18. Military Communications in This Era	12	12
19. New Mobile Units of Army Signal Corps Provide Vital, Strategic Communications	11	5
20. Possibility or Capability	7	30
21. QDC = Quick Dependable Communications	10	13
22. Signal Communications for the Future	9	37
23. Strategic Posture in the Air Age	11	29
24. Tokyo Tower, The	8	32
25. Transoceanic Communications by Means of Satellites	9	42
26. Trends in Telecommunications in the United Kingdom	1	12
27. Visual Missile Communications	3	36
28. Wild Horses and the Functions of Command	1	19
Company Articles		
29. Ceramics Creates a Market (Saxonburg Ceramics)	6	28
30. Hunting by SONAR (Stromberg-Carlson)	8	34
31. Industry Supports Defense (General Tel.)	2	25
32. Let's Talk About Communications (Southern Bell)	8	9
33. Litton Looks Ahead in Meeting Tomorrow's Challenge	9	60
34. Need for Productivity Thinkers, The (Rheem Mfg.)	11	35
35. Role of the Missile Industry in Astronautics, The (Lockheed Missiles)	6	13
36. Services of ARINC Corporation, The	7	51
37. Telecommunications Progress (Automatic Tel. & Electric Co., Ltd.)	4	10
38. United States Electronics Industry's Contribution to National Defense, The (Varian Assoc.)	2	23
Components		
39. Age of Printed Circuitry, The	7	40
40. Components: The Parts of the Picture	7	42
41. From Micro-watts to Mega-watts	7	18
42. Highlights of the Cold Cathode Tube Development	7	50
43. Miniature — Sub-miniature — Micro-miniature	7	12
44. New Parts for New Electronics	7	8
45. Serviceman and Printed Circuits, The	11	14
46. Signal Corps Reports on Army Research in Components, The	7	7
47. Today's Research for Tomorrow's Components	7	22
Defense Programs		
48. Communications and Civil Defense	12	15
49. Extramural Science Programs of the Defense Department	6	8
50. Military Communications in this Era	12	12
51. Strategic Posture in the Air Age	11	29
52. Technology and Defense	7	49
Detection		
53. Anti-Submarine Warfare—A National Problem	9	54
54. Fathometer, The	2	33
55. Frescanar—A 3-Dimensional Radar System with Frequency Scanning	5	16
56. Hunting by SONAR	8	34

(Continued on page 66)

AN ACHIEVEMENT
IN DEFENSE ELECTRONICS



NEW SONAR SIGNAL PROCESSOR DOES WORK OF 1,000 UNITS

The first sonar signal processors to utilize time compression are being produced by General Electric. These new processors were developed in cooperation with the United States Navy. Extracting only critical bits of transmitted and received signals in series, one unit can perform as many correlating operations on a continuous signal—in the same time—as a parallel processor with thousands of units.

Excellent improvement in signal-to-noise ratio also makes these new processors effective against background levels which have formerly made certain signals undetectable by any other practical means. The new equipment is also designed to handle signals from more than one transducer.

This advance in sonar signal processing is typical of General Electric's many achievements in defense electronics. 227-3

Progress Is Our Most Important Product

GENERAL ELECTRIC

DEFENSE ELECTRONICS DIVISION • HEAVY MILITARY ELECTRONICS DEPT. • SYRACUSE, N. Y.

		Issue No.	Page
57.	Klystron—The Creative Core	6	26
58.	Research on Detection of Non-Metallic Mines	6	38

Education

59.	Crisis and Challenge	4	16
60.	Educational Programs in Electronics	12	48
61.	Effect of Modular Design Upon Skilled Technician Requirements	3	42
62.	Maintaining the Strength of U. S. Technology	1	16
63.	New Day for Science, A	10	16
64.	U. S. Education and Science	1	9

Historical

65.	Army Satellites—Teamwork Means Progress (An Historical Account)	10	31
66.	Ceramics Creates a Market	6	28
67.	Educational Programs in Electronics	12	48
68.	Klystron—The Creative Core	6	26
69.	Little Acorns	8	23
70.	Nautilus, The—There Were Two	2	5
71.	SIGNAL Gets Around	6	22

Industry and Defense

72.	Businessman and National Security, The	3	7
73.	Can Industry Meet the Challenge of Communism?	1	5
74.	Industry "Goes to School" at the U. S. Army Signal Supply Agency	10	9
75.	Industry Supports Defense	2	25
76.	Maintaining the Strength of U. S. Technology	1	16
77.	Progress and Survival	9	80
78.	Role of the Missile Industry in Astronautics, The	6	13
79.	United States Electronics Industry's Contribution to National Defense	2	23

Instrumentation

80.	Instrumentation—The Measuring Rod of Technology	5	7

International

81.	MAAG's Pay Their Way, The	8	12
82.	NATO Signals Infrastructure in Allied Command Europe	1	14
83.	Telecommunications Progress	4	10
84.	Tokyo Tower, The	8	32
85.	Trends in Telecommunications in the United Kingdom	1	12

Logistics

86.	Logistic and Industrial Supremacy—The Secret Weapon	3	53
87.	Nurturing of the Late-Blooming Logistician, The	8	35

Management

88.	Air National Guard Communications and Electronics Conference Report	9	86
89.	Army Signal Board, The	6	34
90.	Automation in Traffic Management	1	24
91.	Communications and the Commander	3	14
92.	Decision and Communication	7	34
93.	J-6 (Communications-Electronics) Directorate of the Joint Staff, The	5	25
94.	Management and Control of Military Communications	8	25
95.	Military and Industrial Aspects of R & D Management	12	50-52
96.	NATO Signals Infrastructure in Allied Command Europe	1	14
97.	Wild Horses and the Functions of Command	1	19

Military Training

98.	Educational Programs in Electronics	12	48
99.	Effect of Modular Design Upon Skilled Technician Requirements	3	42
100.	Industry Supports Defense	2	25
101.	Lowry Air Force Base Uses Stereo TV System for Training Technicians	9	49
102.	New Approach to Electronic Training, A, Part I	3	20
103.	New Approach to Electronic Training, A, Part II	4	26
104.	TV in Military Education	4	8

Missiles and Satellites

105.	Advance in Space Power for Peace, The	9	68
106.	Army Satellites—Teamwork Means Progress (An Historical Account)	10	31
107.	Mail by Missile	11	34
108.	Polaris—The Fleet Ballistic Missile Weapons System Program	10	5
109.	Power for the Future	7	14
110.	Role of the Missile Industry in Astronautics, The	6	13
111.	Visual Missile Communications	3	36

Nuclear Power

112.	Advance in Space Power for Peace, The	9	68
113.	Nautilus, The, There Were Two	2	5
114.	Power for the Future	7	14
115.	Radiation Effects in Electronic Devices	3	29

Photography

116.	Photography and the Search for Knowledge	6	15
117.	Photography Rediscovered	9	73
118.	Photoprogress	1	45
		3	50
		5	29
		7	64
119.	Scientific Applications of Photography	12	34

Procurement

120.	Businessman and National Security, The	3	7
121.	Contingent Fees Under Government Contracts	4	30
122.	Face the Facts	2	27
123.	Government Procurement and New Weapons Development System	4	5
124.	Role of Independent Business in Defense, The	5	15
125.	Value Engineering	2	40

Radio

126.	Communications Media for Space Age Systems	3	39
127.	Frequency Density—What the USAF is Doing About It	4	23
128.	Importance of Astronautical Radio in the Space Age, The	9	82
129.	Paging by Radio	3	48
130.	Positive Control of the Electromagnetic Spectrum	9	46

Reliability

131.	Optimum Design for Reliability—the Group Redundancy Approach	5	10
132.	Reliability Through Adequate Specification	11	19
133.	Services of ARINC Corporation, The	7	51

Research and Development

134.	Development Time	3	26
135.	Extramural Science Programs of the Defense Department	6	8
136.	Maintaining the Strength of U. S. Technology	1	16
137.	Materials for the New Technology	8	18
138.	Military and Industrial Aspects of Research and Development Management	12	50-52
139.	Research—A Mark of Growth and Quality	3	19
140.	Research on Detection of Non-Metallic Mines	6	38
141.	Signal Corps Reports on Army Research in Components, The	7	7
142.	Some Aspects of Research and Development Today	12	20
143.	Today's Research for Tomorrow's Components	7	22

Soviet Russia

144.	After the Gap—What?	2	16
145.	Can Industry Meet the Challenge of Communism?	1	5
146.	Challenge in Space	9	32
147	Engineer Looks at Economic Warfare, An, Part I	11	7
148.	Engineer Looks at Economic Warfare, An, Part II	12	38
149.	MAAG's Pay Their Way, The	8	12
150.	Progress and Survival	9	80
151.	Technology and Defense	7	49

Space Technology

152.	Advance in Space Power for Peace, The	9	68
153	Challenge in Space	9	32

TITLE INDEX	Issue No.	Page
154. Challenge of Space, The, Part I	6	5
155. Challenge of Space, The, Part II	7	61
156. Communications Media for Space Age Systems	3	39
157. Electronics in Space	9	27
158. Importance of Astronautical Radio in the Space Age, The	9	82
159. Man's Greatest Conquest—Space	12	30
160. Modern Concepts of Space Communications	12	25
161. Optimum Combination of Man and Machine for Maximum Reliability in Space Travel	12	56-57
162. Positive Control of the Electromagnetic Spectrum	9	46
163. Remarkable Mr. G, The	1	28
164. Research—A Mark of Growth and Quality	3	19
165. Role of the Missile Industry in Astronautics, The	6	13
166. Some Thoughts on the NASA Program	7	27
167. Space Communications	6	20
168. Tools of the Space Age	7	32
169. Transoceanic Communications by Means of Satellites	9	42
170. Trip to Mars, A	5	22
Standardization		
171. Standardization and the U. S. Army Signal Corps	1	31
172. Standardization—The Tested Tool of Progress	3	16
Television		
173. Lowry Air Force Base Uses Stereo TV System for Training Technicians	9	49
174. TV in Military Education	4	8
175. Wide Screen—Television's New Dimension	2	9

Authors' Index

The numbers in the listing below refer to the number of the article in the Title Index.

A

Astin, Dr. A. V., 137

B

Bachtel, Maj. Charles L., SigC, 81, 149
Baird, W. J., 2
Batdorf, Dr. Samuel B., 160
Bennett, Sol C., 122
Bestic, Brig. Gen. John, USAF, 8
Bolstridge, Lt. Col. Leslie J., USAF, 28, 97
Braun, von, Dr. Wernher, 146, 153
Bridges, James M., 95, 138
Burns, John L., 72, 120

C

Castner, Harold W., 6, 9, 69, 71
Cawein, Madison, 175
Chin, James H. S., 131
Clexton, Vice Adm. Edward, USN, 108
Cochrane, John D., 39
Colaguori, V. J., 21
Coleman, Theodore C., 124
Copeland, Col. Royal S., USA, 61, 99
Corderman, Maj. Gen. W. Preston, USA (Ret.) 33
Corvey, E. R., 171
Curcie, Sanford C., 5
Curtis, R. P., 54
Cutler, C. C., 25, 169

D

Distler, Theodore A., 59
Donsbach, W. R., 22
Dreier, Alex, 1
Dreyfus, Maj. Gen. James, USA, 17, 94
du Pont, Henry B., 80

E

Elser, Col. Fred J., SigC, 4

F

Flashman, Col. J. D., USAF, 130, 162

G

Garland, Charles, 159
Gibbs, Col. Charles W., USA, 20, 27, 111
Gilmer, B. S., 32
Glennan, Dr. T. Keith, 157
Gootée, T. E., 15, 19, 55
Grant, Maj. Gen. Harold W., USAF, 23, 51
Greenmeyer, Paul A., 101, 173

H

Haley, Andrew G., 128, 158
Harris, Brig. Sir Lionel, K.B.E., T.D., 26, 85
Hausner, Henry H., 115
Hawkins, Dr. H. V., 170
Hayward, RAdm. John T., USN, 134
Hoegh, Hon. Leo A., The, 48

I

Itschner, Maj. Gen. E. C., USA, 147, 148

J

Johnson, C. F., 115
Johnson, Cdr. John N., USN, (Ret.), 125
Johnson, Dr. Robert L., 73, 145
Johnson, Roy W., 139, 164

K

Kennedy, Hon. John F., The, 144
Killian, Dr. James R., Jr., 62, 76, 136
Kimble, Robert B., 89
Knight, C. R., 36, 133
Krcek, Joseph A., 12
Kunsman, D. H., 45

L

Lang, Air Vice Marshal A. Frank, RAF (Ret.) 57, 68
Lasher, Maj. Gen. Edmund C. R., USA (Ret.) 90
LeMay, Gen. Curtis E., USAF, 18, 50
Lind, Lambert L., Jr., 105, 112, 152
Littell, Brig. Gen. Elmer L., USA, 74
Lukes, George D., 49, 135

M

Mandelbaum, Col. Albert J., USA, 82, 96
March, Stanley A., 29, 66
Matsuo, Dr. Saburo, 24, 84
McDonnell, William Francis, 121
McLean, J. D., 95, 138
McMaster, Donald, 116
Michaels, J. V., 21
Monroe, RAdm. Jack, USN, 108
Montijo, R. E., Jr., 10
Mulé, Maj. Walter, USA, 11, 91

N

Nixon, Hon. Richard M., The, 64

O

O'Connell, Lt. Gen. James D., USA, 3, 14, 46, 92, 141
Ostberg, Maj. Orvil S., USAR, 40

P

Park, August R., 132
Pirie, Vice Adm. R. B., USN, 86

Q

Quarles, Donald A., 52, 151
Quarles, Dr. Gilford G., 154, 155

R

Raborn, RAdm. William F., Jr., USN, 108
Root, L. Eugene, 35, 78, 110, 165
Ruble, Capt. Harold E., USN, 95, 138
Ryerson, Joseph L., 13, 126, 156

S

Saltonstall, Hon. Leverett, The, 123
Sampson, Col. George P., USA, 22
Satterlee, Capt. Francis N., USAF, 88
Shafer, Lt. Col. Robert J., USAF, 127
Signal Staff Report, 30, 31, 56, 75, 93, 100
Skellett, Dr. A. M., 42
Smith, Frank, 118
Sprague, Robert C., 172
Steele, Maj. J. A., USAF, 161
Stewart, Chandler, 58, 140
Stewart, Dr. Homer J., 166
Stoner, Maj. Gen. Frank E., USA, (Ret.), 38, 79
Summerfield, Postmaster General Arthur E., 107

T

Tarkington, Raife, 117
Taylor, Dr. Franklin, 161
Thach, RAdm. John S., USN, 53

U

Upchurch, L. M., 60, 67, 98
U. S. Army Ordnance Missile Command, 65, 106
U. S. Army Signal Research and Development Laboratories, 41, 43, 44, 47, 109, 114, 143

V

Varian, Dr. Russell H., 77, 150
Virden, RAdm. Frank, USN, 7

W

Walker, A. Lightfoot, 34
Ward, J. Carlton, Jr., 142
Waterman, Col. Bernard S., USA, 87
Watts, Brig. Gen. W. Walter, USAR, 168
Weddig, Lee, 129
Wells, Col. B. H., USAF, 102,103
Williams, Maj. Louie L., USA, 104, 174
Wood, H. R. A., 37, 83
Woodford, E. B., 119
Wright, Dr. A. K., 42
Wright, Maj. E. N., USAF, 167

Y

Yarbrough, Dr. John A., 63

New Code Course

(*Continued from page 39*)

"However, plateaus of learning that I had anticipated have not materialized, and the student officers are progressing at their own individual pace which is more rapid than any previous classes taught."

Mr. Bawden, in commenting on the new course, had this to say about it. "The code course set up in the new system is geared to the individual learner. However, the course for group learning of the code had to be slightly modified. The records were re-recorded on magnetic tapes and give 50 minute periods of code transmission.

"Additional flash cards were also needed so that each student could progress at his normal rate.

"After teaching code classes for the past five years on the Army method of code instruction and comparing the results, it is felt that the reinforced learning method of the new system is vastly superior. Students progress more rapidly than with the older method of instruction."

Conclusion

The new system has indicated that students progress much more rapidly than with former methods of instruction. At the present rate of progress, it is estimated that the average class speed for both sending and receiving will be above 13 words per minute after the full 37 hours of instruction. Based on the prerequisite of the student being able to take 6 WPM at the conclusion of the course, it is estimated that approximately ten hours of instruction will be saved with this method.

The success achieved to date is but another example of the results which can be attained through the cooperation and teamwork of industry and the military services.

The opinions expressed herein are those of the author and instructors at the Signal School, and do not necessarily reflect the opinion of the Chief Signal Officer, United States Army.

In closing, I wish to thank Mr. John F. Rider for granting permission to utilize a portion of this material and for his enthusiastic support of the training program at the United States Army Signal School. I also wish to express my appreciation to Captain Robert F. Myers, Mr. Henry G. Bawden, Mr. Joseph D. Liga, Miss Evelyn J. Layton and to the many others concerned, for their assistance in the preparation of the manuscript.

National Advertising Representatives

William C. Copp & Associates

72 West 45th St., New York 36, N. Y. Murray Hill 2-6606

35 E. Wacker Dr., Chicago 1, Ill. FInancial 6-8242

INDEX TO ADVERTISERS

Alden Electronic & Impulse Recording Equipment Co., Inc. 34, 35

Allied Radio Corp.
George Brodsky Adv., Inc...... 48

American Telephone & Telegraph Co.
N. W. Ayer & Son, Inc...... 1

Ampex Corp.
Boland Associates 45

Arnold Engineering Co.
Erwin, Wasey, Ruthrauff & Ryan, Inc. 31

Automatic Electric Co.
Kudner Agency, Inc...... 53

Automatic Telephone & Electric Co., Ltd.
Wesley Associates, Inc...... 61

Bomac Laboratories, Inc.
Larcom Randall Adv., Inc. .....4th Cover

Bulova Watch Co., Research & Development Laboratory
Duncan-Brooks, Inc. 63

General Electric Co., Communication Products Dept.
Brooke, Smith, French & Dorrance, Inc. 15

General Electric Co., Heavy Military Electronics Dept.
G. M. Basford Co...... 65

Hoffman Electronics Corp., Hoffman Laboratories Div.
Honig-Cooper, Harrington & Miner, Inc. 17

Institute of Radio Engineers
Raymond Schoonover Adv., Inc. 6

International Business Machines Corp.
Benton & Bowles, Inc...... 33

Kleinschmidt Div., Smith-Corona Marchant, Inc.
Alex T. Franz, Inc...... 50

Motorola, Inc.
Compton Adv., Inc......23, 24, 25

New York Central System
Cromwell Advertising Agency, Inc. 54

North American Van Lines, Inc.
The Biddle Co...... 37

Philco Corp., Lansdale Tube Co. Div.
Maxwell Associates, Inc....2nd Cover

Radio Corporation of America
Kenyon & Eckhardt, Inc...... 55

Radio Corporation of America, Defense Electronic Products Div.
Al Paul Lefton Co., Inc....3rd Cover

Radio Corporation of America, Semiconductor and Materials Div.
Al Paul Lefton Co., Inc......2, 40

Radio Engineering Laboratories, Inc.
Thomas Franklin Burroughs Co. 11

Stromberg-Carlson Co.
Rumrill Co., Inc...... 9

Sylvania Electric Products Inc.
J. Walter Thompson Co...... 57

Technical Materiel Corp.
Adrian E. Clark, Jr., Adv...... 59

Times Facsimile Corp.
Richard LaFond Adv., Inc...... 43

Transitron Electronic Corp.
The Bresnick Co., Inc...... 13

APPLICATION FOR INDIVIDUAL MEMBERSHIP

ARMED FORCES COMMUNICATIONS AND ELECTRONICS ASSOCIATION
1624 Eye Street, N. W. Washington 6, D. C.

NAME: ..... (Last Name) (First Name) (Middle Name or Initial)

Address .....

Firm or Military Installation:

Title: ..... Type of Work:

U. S. Citizen ☐ or Citizen of

Type of Membership Desired:

Full—$5.00 ☐ Student—$2.50 ☐ Life—$50.00 ☐ Allied—$5.00 ☐

Subscription-Non-Member—$7.00 ☐ Foreign Mailing—$8.00 ☐

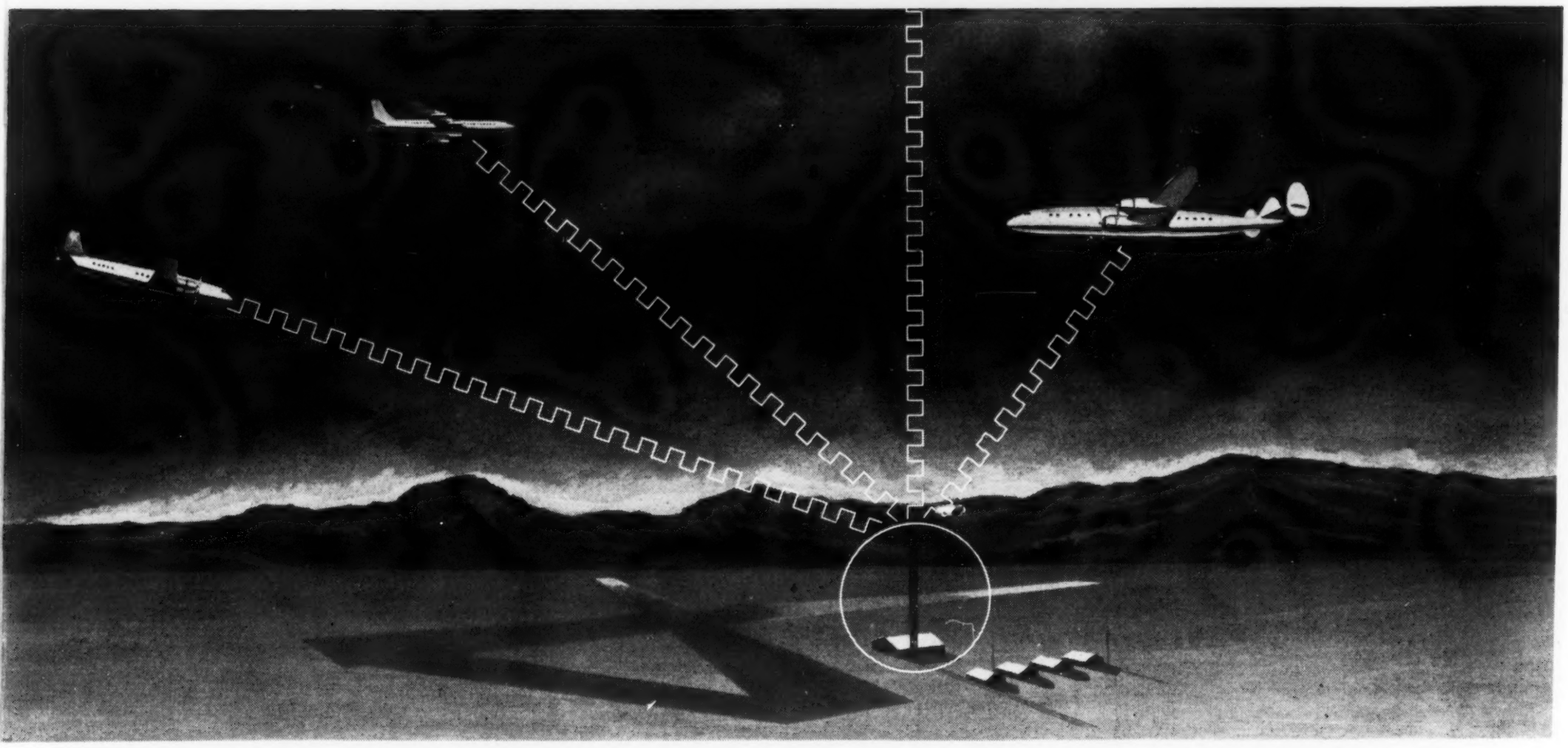
Enclosed find $ ..... for annual dues for AFCEA membership (or subscription) which includes the monthly magazine SIGNAL and Chapter Affiliation.

DATE: ..... SIGNATURE: .....

new
wings
for
words

AGACS

pronounced
"AJAX"



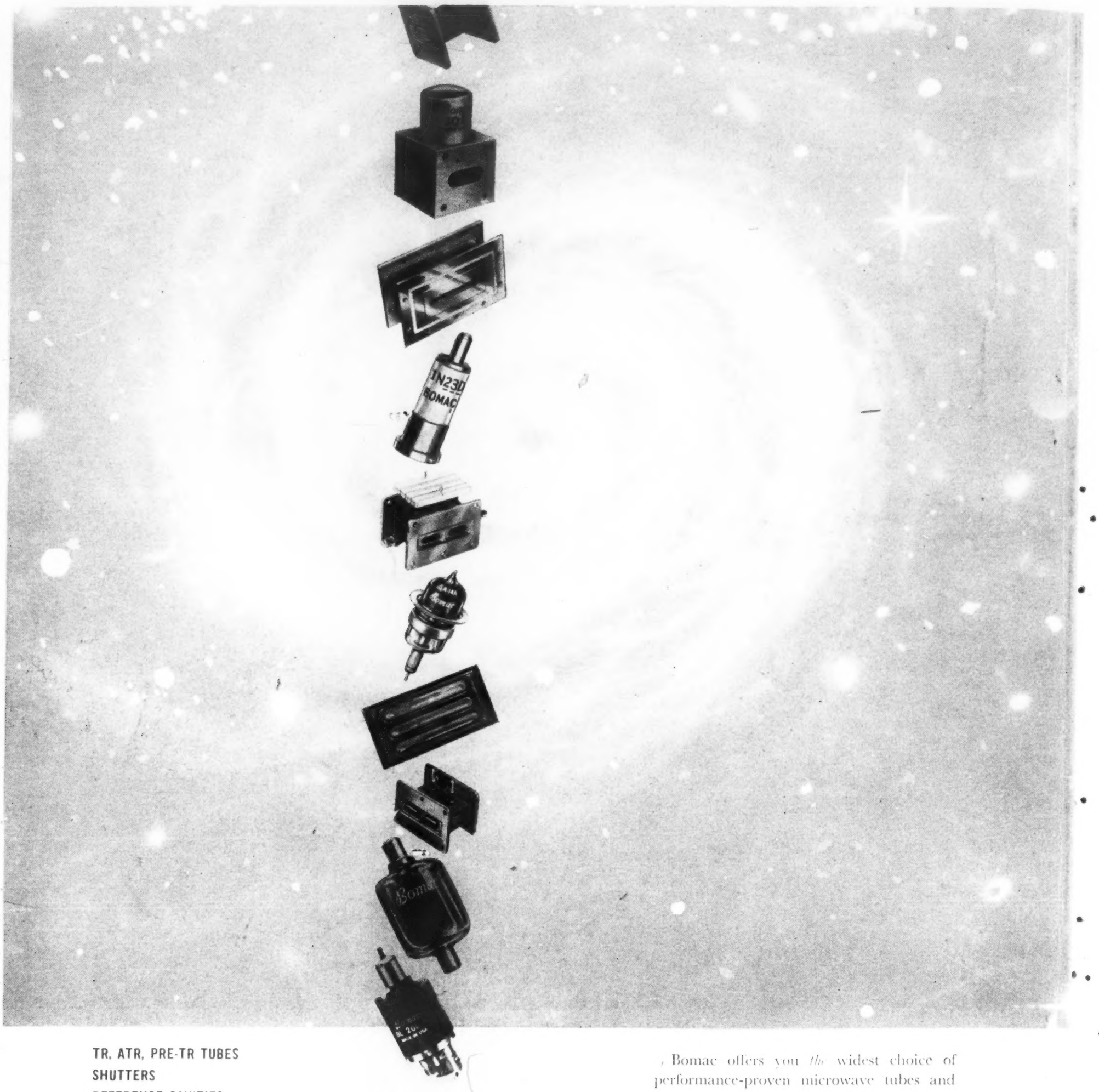
AGACS, Experimental Automatic Ground/Air/Ground Communication System is a new concept in Air Traffic Control Communications to meet the accelerated pace of increased air traffic. Primary objectives are efficient usage of frequency spectrum, added safety through increased reliability and reduced burden to pilot and controller, and adaptability to all classes of aircraft. AGACS provides compatibility with existing ground and airborne communication equipment, selective addressing of information, and a minimum number of frequency changes during flight. The system utilizes two-way time division data transfer over existing ground and air communication links to provide an automatic, mutual exchange of information. The airborne facilities display to the pilot the last significant Air/Ground and Ground/Air message quantities, while the controller may recall from central memory-storage equipment the last Air/Ground and Ground/Air message quantities for display. The AGACS program is still in the developmental stage. In August, 1959, RCA provided initial models of both airborne and ground equipments for the Bureau of Research and Development of the Federal Aviation Agency for extensive experimentation and flight tests.

RADIO CORPORATION of AMERICA

DEFENSE ELECTRONIC PRODUCTS

CAMDEN, N.J.

Tmk(s) ®



TR, ATR, PRE-TR TUBES
SHUTTERS
REFERENCE CAVITIES
SILICON DIODES
MAGNETRONS
KLYSTRONS
DUPLEXERS
PRESSURIZING WINDOWS
SURGE PROTECTORS
SPARK GAP TUBES

THE MOST COMPLETE LINE OF MICROWAVE TUBES AND COMPONENTS

Bomac offers you *the* widest choice of performance-proven microwave tubes and components from which to choose.

And when it comes to adaptations, or totally new designs, there's no substitute for Bomac's 12 years' experience in this specialized, complex, fast-changing field.

Whatever your problem in microwave, check Bomac *first*.

BOMAC laboratories, inc.

SALEM ROAD • BEVERLY, MASSACHUSETTS
A SUBSIDIARY OF VARIAN ASSOCIATES

Offices in major cities — New York • Chicago • Los Angeles • San Francisco • San Carlos, Calif. • Kansas City • Dallas • Dayton • Washington • Seattle • Fort Wayne • Phoenix • Camden, N.J. • Decatur, Ga. • Towson, Md. • Canada: R-O-R Associates Limited, 1470 Don Mills Road, Don Mills, Ontario • Export: Maurice I. Parisier, 741-745 Washington St., N.Y. 14, N.Y.